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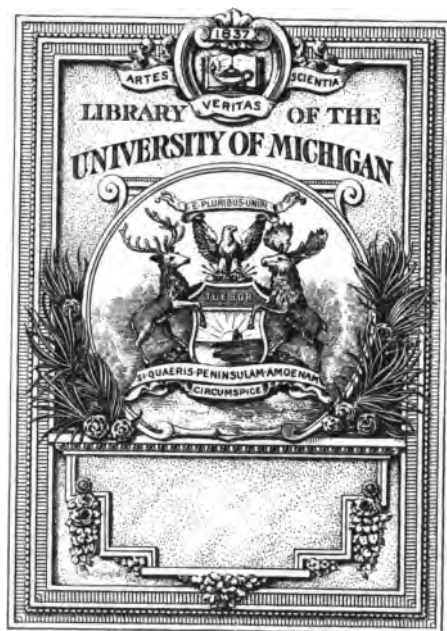
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INDIVIDUAL PSYCHOLOGY:

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A STUDY IN PSYCHOLOGICAL METHOD.

THESIS

PRESENTED TO THE UNIVERSITY FACULTY OF CORNELL UNIVERSITY
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STELLA EMILY SHARP.

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INDIVIDUAL PSYCHOLOGY: A STUDY IN PSYCHOLOGICAL METHOD.

By STELLA EMILY SHARP, Ph. D., Cornell University.

PART I. HISTORICAL AND CRITICAL.

§ 1. *Individual Psychology.*

The systematic consideration of the problems grouped under the name of "Individual Psychology" is of but recent date. Indeed, the only treatment of the whole subject for its own sake is that contained in a paper published in 1895,¹ by Mm. Binet and Henri. A great deal of work has, however, been done by others, outside of France, which properly belongs to this branch of Psychology; notably the investigations by Prof. Kraepelin and his followers in Germany, whose object is by psychological methods to study the mentally abnormal in comparison with mentally normal individuals. For the sake of this comparison the variations in the psychical processes of normal individuals must, Prof. Kraepelin says, first be studied; but the methods employed are such only as are demanded by the comparison that is the main object of the investigation.²

Many American psychologists have made researches in the

¹A. Binet et V. Henri: *La psychologie individuelle*. In *L'Année psychologique*, Vol. II, 1895, pp. 411 ff.

In a foot note to the article *La mesure en psychologie individuelle* (*Revue philos.*, Vol. XLVI, p. 113), M. Binet makes the claim that he is the first French psychologist to employ the term "Individual Psychology."

²E. Kraepelin: *Der psychologische Versuch in der Psychiatrie*. In Kraepelin's *Psychologische Arbeiten*, I, 1, pp. 1 et seq. See also Axel Oehrn: *Experimentelle Studien zur Individual-Psychologie*. *Ibid.*, pp. 92 ff.

field of Individual Psychology; but there has been no unity of method among the investigators, nor have the results been systematized or their value estimated. An important characteristic of most of this work, however, is the large proportion of anthropometric tests, which are accorded an importance equal to those which are strictly mental.¹ In the class of the more exclusively psychological investigations may be named the experiments of Prof. Jastrow concerning the community of ideas between men and women, made at the University of Wisconsin, and similar experiments made by Prof. M. W. Calkins at Wellesley College;² as well as a brief study in Individual Psychology by Miss C. Miles, which makes use of the method of the questionnaire.³

It is clear, then, that any treatment of Individual Psychology almost necessarily involves a consideration, more or less complete, of the work done by Mm. Binet and Henri. For this purpose it is well to ask first of all what views these authors take of the scope and relations of Individual Psychology. Individual Psychology, they maintain, takes up the thread of investigation at the point where General Psychology leaves it. "General Psychology studies the general properties of psychical processes, those, therefore, which are common to all individuals; Individual Psychology, on the contrary, studies those psychical processes which vary from one individual to another: it seeks to determine the variable qualities, and the extent and manner of their variation according to the individual." Memory may very well illustrate the point. The law of memory is as follows: the time necessary to fix impressions in

¹ Tests employed by Prof. Jastrow at the World's Fair of Chicago in 1893. Analyzed in *L'Année psychologique*, Vol. I, p. 532. See also J. McK. Cattell, *Mental Tests and Measurements*. *Mind*, 1890, Vol. XV, pp. 373 ff.; J. A. Gilbert: *Researches on the Mental and Physical Development of School Children*. *Stud. Yale Laboratory*, II, 1894; J. McK. Cattell and L. Farrand, *Psych. Rev.*, Vol. III, 1896, pp. 610 ff.; J. Jastrow and G. W. Morehouse: *Some Anthropometric and Psychologic Tests on College Students*. *Am. Jour. of Psychology*, Vol. IV, pp. 420 ff.

² The original account of these experiments appeared in an article entitled *A Study of Mental Statistics*, in the December, 1891, number of the *New Review*, under the heading "The Community of Ideas and Thought-Habits of Men and Women." It appeared also in the article *Community and Association of Ideas: a Statistical Study*, by J. Jastrow; *Psych. Rev.*, I, p. 152 (1894). Similar experiments made at Wellesley College by C. C. Nevers, under the direction of M. W. Calkins, *Psych. Rev.*, Vol. II, p. 363 (1895), gave a different result. A criticism of the latter by Prof. Jastrow appeared in the *Psych. Rev.*, Vol. III, p. 68 (1896). A reply to this by Miss Calkins is found in the same volume of the *Psych. Rev.*, p. 426; and a further reply by Prof. Jastrow, p. 430. Both investigations are discussed and criticised by Amy Tanner, *Psych. Rev.*, Vol. III, pp. 548 ff.

³ *Am. Jour. of Psychology*, VI, p. 534.

memory increases at first proportionally to the number of impressions; but, after a certain limit, the 'time of acquisition' increases more rapidly than the number of impressions. This law of memory is common to all; no one can escape it; but the law does not say that the limit, beyond which the time necessary to retain the impressions is no longer proportional to the number of impressions, is fixed and common for all. This limit is a variable property of memory, and here Individual Psychology comes in, and investigates the subject in its different aspects; it enquires in what measure this limit varies in different individuals, and whether it remains constant in one individual for different kinds of impressions. If *A* and *B*, after one hearing, can remember ten and seven letters respectively out of twelve, can they remember with the same relative readiness an equal number of figures, colors, or what not? Individual Psychology goes on, further, to enquire if there is any relation between the position of this limit and the psychological 'self' of the individual, — as, for example, his age; or between the limit of memory and some other psychical process.

§ 2. *The Psychology of Structure and of Function.*

Before proceeding to a more detailed statement of the problems of Individual Psychology, as set forth by M. Binet and his collaborator, a digression must be made in order to consider a distinction that has lately been drawn between the points of view of 'experimental' and of 'descriptive' psychology. This distinction is set forth by Prof. Titchener in an article entitled "The Postulates of a Structural Psychology."¹ A comparison is here made between the science of biology, in its widest sense, and that of psychology. The former may be approached from any one of three points of view.

"We may enquire," says Prof. Titchener, "into the structure of an organism, without regard to function, by analysis determining its component parts, and by synthesis exhibiting the mode of its formation from the parts. Or we may enquire into the function of the various structures which our analysis has revealed, and into the manner of their interrelation as functional organs. Or, again, we may enquire into the changes of form and function that accompany the persistence of the organism in time, the phenomena of growth and decay. Biology, the science of living things, comprises the three mutually interdependent sciences of morphology, physiology and ontogeny."

If a more general view is taken, and regard is had for the whole number of living beings as parts of a collective life, we have, corresponding respectively to the three branches named, the more general sciences of taxonomy or systematic zoölogy, the science of classification; oecology, which deals with ques-

¹ *Philosophical Review*, Vol. VII, pp. 449 ff. Sept., 1898.

tions of geographical distribution, of the function of species in the general economy of nature; and phylogeny, the biology of evolution, dealing with the problems of descent and of transmission.

The same principle of division here employed in biology may be applied with equal validity to psychology.

"We find a parallel to morphology in a very large portion of 'experimental' psychology. The primary aim of the experimental psychologist has been to analyze the structure of mind; to ravel out the elemental processes from the tangle of consciousness. . . . His task is a vivisection, but a vivisection which shall yield structural, not functional results. . . . There is, however, a functional psychology over and above the psychology of structure. We may regard mind, on the one hand, as a complex of processes, shaped and moulded under the conditions of the physical organism. We may regard it, on the other hand, as the collective name for a system of functions of the psychophysical organism. The two points of view are not seldom confused. The phrase 'association of ideas,' *e. g.*, may denote either the structural complex, the associated sensation group, or the functional process of recognition and recall, the associating of formation to formation. In the former sense it is morphological material, in the latter it belongs to what I must name (the phrase will not be misunderstood) a physiological psychology. Just as experimental psychology is to a large extent concerned with problems of structure, so is 'descriptive' psychology, ancient and modern, chiefly occupied with problems of function. Memory, recognition, imagination, conception, judgment, attention, apperception, volition, and a host of verbal nouns, wider or narrower in denotation, connote, in the discussions of descriptive psychology, functions of the total organism."

So much for the 'morphological' and 'physiological' psychologies, which are indeed the most important. The other branches of biology have also their counterparts. Ontogenetic psychology, the psychology of individual childhood and adolescence; taxonomic psychology, dealing with the classification of the emotions, impulses, temperaments, the typical mind of social classes, etc.; the functional psychology of the collective mind, which has as yet been but little worked out; and, lastly, phylogenetic psychology, enriched by the labors of the evolutionary school, complete the list.

§ 3. *The Problems of Individual Psychology.*

Mm. Binet and Henri class the problems of Individual Psychology under two main headings. It is called upon:

1. to study the variable properties of psychical processes; to find how, and to what extent, these processes vary from one individual to another; and
2. to ascertain the relation of the processes to each other in a single mind; to find out whether they are mutually dependent, or whether there are some fundamental processes upon which all the others depend.

A. The First Problem of Individual Psychology.

The first problem has two aspects, according as emphasis is laid upon the processes themselves, or upon the individual who experiences them. The first aspect is the one with which Individual Psychology must necessarily start. How and to what extent mental processes vary from one individual to another is the question which must be answered, to furnish, as it were, the materials for further investigation. Then we may go on to ask if these variations follow any regular laws, corresponding to the classification of individuals into groups by profession, sex, age, etc.

A considerable number of independent investigations have been made in the line of this first problem of Individual Psychology, under both its aspects. Sensations are the processes which have been subjected to the greatest amount of research, on account of their value for some practical end. The tests in regard to individual variations in visual sensations, such as color blindness, which have been made among engineers, pilots, and in other professions whose members are called upon to recognize color signals, are experiments of this kind. Mm. Binet and Henri state, as the result of a brief historical survey of the work in this field, that "the individual differences for sensation are very feeble and insignificant in relation to the differences in the higher faculties." Hence much of the work done is of comparatively little value for Individual Psychology, which seeks to characterize individuals and classes according to the variations which they exhibit in the mental processes composing the 'real' or 'actual' mind of every-day life.

Other researches have been carried out, in which the emphasis has been laid, not upon the variations themselves, but upon their relation to the individual; and the individual's mental processes have been studied in reference to the class to which he belongs. The investigations of Prof. Jastrow and Miss Calkins regarding the Community of Ideas in men and women (mentioned above) come under this head. The investigations of what may be called 'professional psychology' also belong here, and would be of the highest importance for Individual Psychology were it not that they fail to apply a strictly scientific method. As it is, however, they are rich in suggestions of more exact work, and may thus lead to systematic research along the same lines.¹

¹ L. Arréat: *Psychologie du peintre*. Paris, 1895. This considers anthropological as well as psychological traits, and the author has drawn his material largely from literature, biographies, and documents of all kinds concerning artists of every time and country. Owing to the imperfect nature of the material, the conclusions are

The question now arises whether the first great problem of Individual Psychology should be classed as an enquiry of 'structural' or 'functional' psychology. In the first place, is the *material* with which the Individual Psychologist works the same as (or similar to) that which lends itself to the investigation of the Experimental Psychologist? The Experimental Psychologist takes mental processes in as simple a form as he can find them. By means of laboratory methods, he exercises the most rigid control over conditions, in order that all complicating factors may be excluded, and that the result may represent as nearly as possible the working of the elemental factors. Thus the Experimental Psychologist, acknowledging that a pure sensation is an abstraction,—that it never occurs in our concrete experience,—yet endeavors by artificial means to secure in his subjects states of consciousness in which the desired sensations are sufficiently isolated from their respective contexts to give information as to their properties and the laws governing the variations of these properties.

Does the Individual Psychologist adopt a similar method of procedure? Is it his aim to take the simplest existing processes, in order to investigate any possible individual variations, and thus to account for unlike results from the building up of unlike materials? It is by the answer to this question that two groups or schools of Individual Psychology are differentiated. M. Binet and the French psychologists answer "no;" Prof. Kraepelin and the German psychologists answer "yes." The American psychologists make no explicit statement on the subject, but their practice is rather with the German than with the French school. The German school maintains that, at least for the present, only simple mental processes can be studied with the exactness necessary for scientific work. "Die Probleme der Individual-psychologie können bisher nur in

necessarily exceedingly general. Prof. James denies this work the adjective 'scientific.'

L. Dauriac: *Psychologie du musicien*, Articles I-VII. *Revue philos.*, Vol. XXXV, pp. 449, 595; Vol. XXXIX, pp. 31, 258, 404; Vol. XLII, pp. 1, 155.

Harmon: *Psychologie du militaire professionnel*. Paris, 1894. This is a work which belongs to sociology more than to psychology. It traces the moral effects of army life and the reaction of these upon society.

A. Binet et J. Passy: *Études de psychologie sur les auteurs dramatiques*. *L'Année psychol.*, I, pp. 60 ff. The creative imagination is here the chief subject of investigation. A number of French dramatists give information, either by word of mouth or in writing, regarding the composition of their works; the choice of subject, the method of literary labor, the 'furniture' of the mind during inspiration, etc. The 'interview,' like the questionnaire, is a valuable auxiliary method; but the results therefrom cannot claim the validity of the stricter laboratory procedures.

ganz einfachen Formen psychischen Geschehens gesucht werden."¹ Mm. Binet and Henri make explicit and repeated statements of the opposing standpoint in the article which we have been considering. On p. 417 is found the passage here translated. "The higher and more complex a process is, the more it varies in individuals; sensations vary from one individual to another, but less so than memory; memory of sensations varies less than memories of ideas, etc. The result is, that if one wishes to study the differences existing between two individuals, it is necessary to begin with the most intellectual and complex processes, and it is only secondarily necessary to consider the simple and elementary processes."

An examination of particular investigations which have been made by representatives of these two schools will enable us to judge whether the principles of each have been strictly adhered to. Kraepelin and Oehrle must be taken as the German representatives. Kraepelin, in the first number of the 'Psychologische Arbeiten,' lays down the principles, methods and aims of the work which he proposes to undertake. Oehrle—in part, at least—carries out these methods, and the results are embodied in the second article of the same number of this periodical.

Since for Kraepelin men are divided into two great classes, the mentally normal and the mentally abnormal, all individual differences are summed up for him under the one great category of *mental capacity*. It is his aim to learn as much as possible about the psychology of the abnormal mind. For this purpose investigations of the normal mind are first necessary, and then further investigations of the normal mind, under certain abnormal conditions which produce consciousnesses comparable to those normally present in the insane. The differences in mental capacity, therefore, which Kraepelin considers subject to experimental investigation, are those which are most directly connected with physical conditions. The kinds of mental capacity to be thus investigated he classes under the three heads of capacity for the perception of sensory stimuli; for the association of ideas, and for voluntary movement. The psychophysical *conditions* which are studied under these three heads are the influence of practice and the persistence of the effects of practice, the capacity of the special memories, the influence of fatigue and the capacity of recovery from fatigue, the depth of sleep, and the capacity for concentration of the attention. Prof. Kraepelin states that this list is as far as can be from exhausting the conditions which it is possible and even necessary to determine experimentally; but he affirms

¹ Max Brahn: *Zeit für Ps. u. Ph. d. Sinnesorgane*, Vol. XII, p. 280.

that it is upon the basis of an investigation such as this that the study of personalities must be founded.

The operations, suggested by Kraepelin and adopted by Oehrn, that are chosen as affording means for the investigation of these conditions are as follows: 1. Perception: the counting of letters, the search for particular letters, proof reading. 2. Memory: the learning of twelve nonsense syllables, and of series of twelve figures. 3. Association: the addition of series of one-place numbers. 4. Motor functions: writing from dictation, and reading as fast as possible.

The time aspect alone of these operations is noted experimentally. The absolute durations of the processes, and their mean variations, give information in regard to the general mental capacity of the individuals tested, and to the relation of the processes to each other in respect of complexity, etc.

The fluctuations in the rate of the processes during periods of continuous work, or after stated intervals of rest, show the influence of practice in increasing the efficiency of work, of fatigue in decreasing this efficiency, and of rest in increasing the efficiency by means of the removal of fatigue, or decreasing it by obliterating the effects of practice, according to the length of the rest interval. A strict numerical expression is given to all the facts thus deduced. "If we wish to be instructed," says Oehrn (p. 144), "concerning the psychical efficiency of a person, we ask first concerning the quantity of work he can do in a certain time, or the time necessary to do a certain amount of work. We shall, therefore, have to consider in the first place the individual differences in the absolute duration of the functions investigated" (*i. e.*, the average time, in thousandths of a second, that it takes to count one letter, to read one syllable, to write one letter, to make one addition, or to learn one number or syllable). "The second question is as to the quality of the work, by which alone the value of the quantity may be estimated." A direct answer to this latter question Oehrn does not attempt to give in his work, but considers the omission of secondary importance, since all of his subjects had attained a degree of education where large differences in the quality of the particular processes tested could hardly enter. "Further, it is of importance," he continues, "for judging an individual, to know if he is in condition to work with constancy. If this is not the case, the quality of the work must suffer on the one hand, while on the other, large fluctuations will also indicate a diminution of quantity, since they are to be taken as evidences of fatigue. Hence the more numerous and larger the fluctuations are, the lower must be our estimate of the psychical energy of the individual considered." The mean variations in time give numerical representations of these fluctuations.

"Finally, we have to ascertain how the subjects behave in regard to practice and fatigue. It is necessary to distinguish between that practice which enters into a single experiment, . . . and the permanent practice which manifests itself, in a repetition of the experiment, by a shortening of the time necessary to perform the work." The mean variations and the relation of practice and fatigue in an individual are considered as of more importance for judging his capacity than the absolute duration of his work. Tables are given, presenting the numerical results in each of these regards, obtained from every one of Oehrn's ten subjects. From the Tables a comparison of the subjects could be made; but Oehrn leaves this comparison to be made by the reader. He is chiefly concerned to show that by the aid of the method he has described it is possible to obtain a conception of the psychical status of an individual. To establish a normal status would be the task of far more extended investigations.

Contrast with this work in Individual Psychology an investigation made in France, by Mm. Binet and Henri, on Memory for Sentences (Memory for Ideas).¹

In the memory of figures or letters, it is chiefly auditory, visual or tactual sensations that are retained: the memory is one of relatively simple conscious elements. Memory of isolated words approaches this in its essential character; for, though the sense of the words enters here, and the memory is partially a memory of ideas, yet it is impossible in experiments upon the memory of isolated words to determine how much influence upon the subject's power of recall is due to the sense of the words, and how much is due simply to the subject's desultory memory, or memory of separate, unconnected impressions. Hence it is necessary to investigate the memory of ideas by itself.

Mm. Binet and Henri chose eight sentences, or closely connected groups of sentences, ranging in length from 11 to 86 words. These sentences were read before the pupils of several classes in four elementary schools in Paris. The children were required to reproduce the sentences in writing immediately after hearing them. The attention of the pupils was properly directed, since an explanation of the requirement was given to them in advance. The main work in the investigation was,

¹ A. Binet et V. Henri: *La mémoire des phrases (Mémoire des idées)*. In *L'Année psychologique*, I, 1894, p. 24. This article appeared before that on Individual Psychology by the same authors, and the investigation is not explicitly termed an investigation in Individual Psychology. The test employed is, however, closely similar to one proposed in the latter article, and represents very fairly the kind of material which the writers believe Individual Psychology should employ.

of course, the interpretation of the results handed in by the pupils. The number of children submitted to the experiments was about 510.

One of the chief difficulties in the interpretation of results lies in the fact that not every word in the sentence or sentences represents an independent idea. One cannot say that there are just as many ideas in the sentence as there are words. Pronouns, articles, prepositions, etc., have no meaning apart from other words with which they are closely connected; and short phrases are remembered as a single idea. Hence it became necessary to separate the sentences into word-groups, each group representing as nearly as possible one idea. Here is an example of this division of one of the shorter sentences: a sentence of 20 words and 8 groups of words:

Le petit Émile | a obtenu | de sa mère | un joli | cheval mécanique | en récompense | de sa bonne conduite | à l'école. |

In the longer sentences or series of sentences the division becomes more difficult and assumes a more or less arbitrary character. A passage of 60 words and of 19 groups may show this:

Une vieille paysanne | âgée de 64 ans, | la veuve Mouillet, | qui habitait une petite maison | sur la route déserte | des Recolets | avait conduit | son troupeau | dans les champs. | Pendant qu'elle faisait de l'herbe pour ses animaux | une vipère | cachée derrière | les fagots—s'élança sur elle | et la mordit | à plusieurs reprises | au poignet. | La pauvre femme | en est morte. |

The results obtained from the investigation were, in brief, these. 1. Memory for sentences (or ideas) shows a slight but constant increase with age. This was ascertained from the fact that in the higher classes more groups of words were completely retained, and fewer words totally forgotten,—*i. e.*, entirely left out, without any substitution whether right or wrong,—than in the lower classes where the pupils were younger. 2. The memory for sentences is, in certain fixed conditions under which these experiments were tried, twenty-five times superior to the memory for isolated words. 3. The number of forgotten words increases rapidly with the length of sentences or series of sentences; for a sentence of 20 words (8 groups) it was $\frac{1}{10}$, while for a series of 80 words (24 groups) it was $\frac{1}{3}$. 4. The losses of memory fall upon accessory parts of the sentence, not upon the essential parts, *i. e.*, not upon the parts that are logically or psychologically important. 5. In short selections there are more substitutions of synonymous words than there are completely forgotten words, but in long selections the reverse is the case. In short sentences, though the particular words may be forgotten, the ideas are remembered, and the child invents his own terms. We find, therefore, a large number of synonyms. In long selections, however, the

ideas themselves are too numerous to be remembered, and the completely forgotten words outnumber the synonyms. 6. Children have a tendency to simplify the syntax, and to replace the words read to them by other words taken from their own more familiar vocabulary. This Mm. Binet and Henri call 'verbal assimilation.' 7. When sentences are somewhat long, children show a tendency slightly to alter the meaning of the sentence. These alterations are frequently by way of additions, and may be of two kinds, intellectual and emotional.

It will be seen that the only factors in this problem that lend themselves to numerical expression are (1) the *quantity* of words or groups remembered, substituted, or forgotten by any pupil; (2) the number of pupils who remember or forget any particular word or group; and (3) the age of the pupils who remember best or worst.

The character of the material employed in this investigation is clearly and confessedly of the complex type. Although the sentences are mainly concrete, as suited to the child mind, they yet imply a considerable faculty of generalization and a synthetic power of attention in combining the various ideas into a situation. The mental processes involved are therefore highly complex, and the investigators have here used the material which they assert to be most suitable for the examination of the Individual Psychologist.

Has the material of the German psychologists the opposing character of extreme simplicity? The only simplicity that Kraepelin claims for his work is simplicity of *method* (method of continuous work). This has to do, not with the measurement of single independent acts, but with the continuous performance of regularly connected similar acts. The acts or processes themselves are not simple. Oehrn has analyzed each into three phases: the centripetal phase, or process of perception; the central phase, or process of association; and the centrifugal phase, or process of movement. The three phases vary in importance and duration in the different kinds of operations used in the experiments, and the fluctuations observed in continuous work may therefore be due to alterations in that phase of the whole process which is predominantly involved in the exercise in question. This analysis is, however, far from being an analysis into the simplest psychological elements, made for the sake of detecting variations in these elements. We are free to conclude, therefore, that the material used by the Individual Psychologist is, as a rule, less simple than that upon which the general Experimental Psychologist spends his best efforts.

Nevertheless, the distinction between the German and French schools is not invalidated by this statement. There is a con-

siderable degree of difference in the complexity of material employed by these two schools, and there is a still greater difference in method resulting from the difference in material. The more exact methods of the Germans are inapplicable to the tests which the French insist upon as of primary importance to the Individual Psychologist. It is, perhaps, on account of this difference in method that Mm. Binet and Henri, by a slight confusion, exaggerate the difference in the material employed by themselves and by other Individual Psychologists. The specific criticism which they pass upon Prof. Kraepelin's work, however, is not so much that it lacks complexity as that it lacks scope. The experiments are too partial, they say, and for that reason entirely fail to characterize an individual.¹

The position of Mm. Binet and Henri may be more clearly understood if we notice briefly some of the 'mental tests' proposed by American psychologists. The tests given by Prof. Jastrow at the World's Fair at Chicago² are among the most complete. There are here five different experiments for touch and cutaneous sensitivity; five experiments for sight and touch together (such as the equalizing of movements by sight); twelve or more experiments for sight alone, including appreciation and division of lengths, rapidity and acuteness of vision, etc. Other tests have to do with memory for letters, lines, colors and forms, and with simple reaction times. Place is also given to anthropometric tests of height, development of the head, and the relation of mental to physical development, etc. It will be seen that these experiments have chiefly to do with sensations and simple movements. Even the memory tests have regard to memory for sensations rather than to memory for ideas.

Other lists of tests given by American psychologists show the same characteristics. Prof. Cattell, in an article in *Mind*,³ gives the results of two different series of tests, one numbering ten and the other fifty. The first series is as follows: (1) pressure measured by the dynamometer; (2) maximal rapidity of arm movement; (3) minimal distance between two points on the skin which can be perceived as two; (4) pressure necessary to produce pain; (5) least perceptible difference for weight of 100 gr.; (6) time of simple reaction to an auditory impression; (7) time necessary to name a color; (8) division of a length of 50 cm. into two equal parts; (9) reproduction of an interval of ten seconds; and (10) number of letters retained after a single hearing. The longer series is analogous to this, the same relative importance being given to the elementary processes.

¹ P. 432.

² These are analyzed in *L'Année psychologique*, Vol. I, p. 532 (1894).

³ *Mental Tests and Measurements*. *Mind*, 1890, Vol. XV, p. 373.

The "Researches on the Mental and Physical Development of School Children," by Dr. J. A. Gilbert,¹ employ the following tests: (1) muscle sense; (2) sensitivity to color differences; (3) force of suggestion; (4) voluntary motor ability; (5) fatigue; (6) weight; (7) height; (8) lung capacity; (9) reaction-time; (10) discrimination-time; and (11) time-memory. All these tests are subject to exact numerical measurement. The muscle-sense was measured by the least perceptible difference in gr. of lifted weights; sensitivity to color-difference was measured by the shades of red-colored fabric picked out by a child as being alike (every piece of fabric being in reality slightly and measurably different in shade); force of suggestion was determined by the difference in gr. between two weights of the same bulk but unequal weight, which the child picked out as being equal respectively to a weight large in bulk and one small in bulk which (unknown to the child) were of equal weight. For the experiments on voluntary motor ability and fatigue, reaction-time, discrimination-time and time-memory, Dr. Gilbert constructed an apparatus which he calls the reaction-board. This board holds a magnetic tuning fork, vibrating one hundred times per second; a double-post switch; a stimulating apparatus; a reaction key; a tapping apparatus; a commutator, and an Ewald chronoscope. The electric current is supplied by two Grove batteries. Voluntary motor ability was measured by the number of taps the child made on the tapping apparatus in five seconds, and fatigue by the per cent. of loss of rapidity of tapping after the movement had been continued for 45 seconds. Reaction-time and discrimination-time were measured by the chronoscope, in hundredths of a second. The time-memory was measured by allowing the chronoscope to run a certain length of time, and then starting it a second time, and requiring the child to press the key when the second running had lasted as long as the first. The difference between the two periods of time marked the accuracy of the time-memory. Weight, height, and lung capacity were measured by standard instruments suited to these purposes.

The detail which has been given is sufficient to illustrate the difference in material and method between the French Individual Psychologists, and those engaged in similar work in America. It may be said, therefore, in general, that there is a wide divergence in opinion and practice among the investigators of Individual Psychology, as to whether the first problem of the science, on the score of material and method, is properly of a structural and morphological character, or whether it should be classed as belonging to a functional or 'physiologi-

¹ *Studies from the Yale Psychological Laboratory*, II (1894), p. 401.

cal' psychology. The Americans make it approximate to the former character; the Germans seem to favor the former in regard to method, but hold a middle position in regard to material; while the French psychologists depart as far as possible from the point of view of morphology, both in material and in method. The American view is founded upon no explicit theory of Individual Psychology. It may, therefore, be temporarily set aside. Considering only the French and German psychologists, we find that Individual Psychology seems, on the whole, rather to fall outside of structural psychology. It might be, however, that strict analysis of the results obtained from the study of complex processes would give information in regard to the ultimate elements. Is this, in reality, the case? The outcome of the researches we have hitherto noticed would seem to indicate a negative reply. But it is too early, yet, to look for an entirely decisive answer. Until a more thorough investigation of the methods proposed by Individual Psychology, or possible to it, is carried out, the question must be left undecided.

B. The Second Problem of Individual Psychology.

Individual psychology has to study not only the variations of mental processes from one individual to another, and the relation of these to individuals or classes of individuals, but also the relations of the mental processes to each other in the mind of one and the same individual. Are all the mental processes definitely related and correlated? Is there one process more important than all the rest, so that a variation in this process involves a perfectly definite variation in all the other processes? Or, on the other hand, are there a large number of mental processes, practically independent of each other, and capable of assuming an almost infinite variety of combinations in as many individuals?

Again we have to ask whether this inquiry by Individual Psychology is of a structural or physiological character. The answer is not far to seek; it is, in fact, implied in the very form in which the questions of this second problem clothe themselves. It is the investigation of the relation to each other of the various *ways of working* of the psychological organism. It is, therefore, the psychological problem which corresponds to the general problem of physiology. As the latter asks what are the basal functions of the living physical organism, so the former seeks to find in the mental sphere those activities whose relations to each other and to the psychological organism are analogous to those existing between functions in the sphere of physical life. The problem may, and does, imply analysis; but it is an analysis of which the common activities of every-day

life form the starting point, and their better understanding, the goal. The atomistic point of view is abandoned, and the mental activities of man are taken, as it were, in the large; and the various relations of these activities, partially seen and understood by common observation, are confirmed, explained, and rendered explicit by the use of the experimental method. This is the task laid down as the second problem of individual psychology,—a task which belongs, therefore, to the psychology of function.

The difficulties attendant upon an investigation of the questions involved in this branch of Individual Psychology are very great. The mental processes which make up the sum of everyday psychical activity are of so complex a nature that it may be doubted whether experimentation can be applied in such a way as to yield results which meet the requirements of scientific precision. Mm. Binet and Henri have, however, discussed three methods by which investigation may be carried on. (1) The first method is that of abnormal cases; wherein advantage is taken of instances where there is extreme development or enfeeblement, or even loss, of some psychical processes, to study the consequent modification of other processes. Where there is a loss of memory, *e. g.*, we may try to find the effect of such loss upon imagination, power of concentration of the attention, etc. That is to say, the object is to ascertain whether the presence of an abnormal activity involves a definite deviation from the normal on the part of other mental processes. The collection of a large number of investigations of this kind would show the relation in which these processes stand to one another. There is, however, a difficulty. How shall we determine the *amount* of deviation from the normal, which one process must possess in order to entail a corresponding deviation of other processes? This question must be answered by means of experimentation, before the more general problem can be solved.

This method has been employed to some extent, and has furnished some important information. By its means was ascertained the fact of the independence of the partial memories;¹ the fact, *i. e.*, that we "can have an extraordinary memory for figures, without in the least excelling in memory for letters, or colors, or any other impressions whatever." Moreover it has shown that a total loss of some partial memories may fail to show any influence upon the other partial memories.²

(2) Another method, one that is applied to normal indi-

¹ By A. Binet: *Psychologie des grands calculateurs et joueurs d'échecs*.

² Mm. Ribot and Charcot, quoted by Binet and Henri.

viduals, may be stated thus: "In a single individual one may vary a psychical process, and see if this variation involves changes in other processes in the same individual." For this purpose only those processes are chosen which are useful for the comparison of individuals. Experiments upon sensations, manner of fatigue, etc., are thus eliminated. The practical application of this method is attended with great difficulty, owing to the complexity of the conditions. It depends, evidently, upon the possibility of placing an individual, by artificial means, in such a condition that certain mental processes shall be performed in the way in which they take place normally in certain other individuals. An individual who gave a quick reaction time, owing to great power of attention, might, by having his attention artificially distracted, lengthen his reaction time until it corresponded to that of other individuals who normally gave long reaction times from small power of attention. Given a constant correspondence between length of reaction time and degree of concentration of the attention, and the rapidity of reaction of an individual might be taken as an index of his power of attention.

This method has been applied by Prof. Kraepelin, in his investigation into the influences of slight poisons upon certain psychical processes: these poisons producing, in a normal individual, effects analogous to those caused by certain mental diseases in their early stages. Valuable as the method may be in theory, however, its range of application is necessarily limited, and it is, according to Mm. Binet and Henri themselves, more useful as a source of suggestion than as affording specific results.

(3) The third method, which is likewise the simplest and most practicable, is that in which the experimenter chooses in advance a number of psychical processes, and proceeds to study them in several individuals, noting whether the individual differences in the different processes run parallel to each other, and correspond in a regular manner. From such correspondence he can infer the existence of a more or less close relation among the different processes. The experiments of Oehrn and Gilbert, which have been commented on above, are partial applications of this method, as are also the various 'mental tests' proposed by American psychologists. The disadvantage of the latter, according to Mm. Binet and Henri, is that they are calculated to give but little information in regard to the second problem of Individual Psychology, since they pay but slight regard to the complex processes. The method itself has the advantage of serving equally well for the study of either of the two problems of Individual Psychology. The results may be looked at with a view to ascertaining the variations which occur in the chosen processes from one individual to another,

and the relation of these variations to the sex, age, profession, etc., of the individuals in whom they are observed; or the results may be studied in regard to the correspondences which may constantly manifest themselves between the different processes in any single individual. For the latter point of view, however, it is necessary that the processes chosen for investigation shall be of that complex character which distinguishes the every-day activities of one individual from those of other individuals. Mm. Binet and Henri affirm this with emphasis. They say (p. 426): "Is it necessary to know that *A* has a finer tactual sensibility than *B*, that he can distinguish between two colors better than *B*, or that he can move his arm faster than *B*, in order to distinguish these individuals from each other? Certainly not. On the other hand, how could one try to characterize them, and to distinguish them from each other, if one had no data concerning their imagination, their memory, their power of attention, their power of observation, their power of analysis, their reasoning, their stability of will, their affective life, etc.?" That these activities are more difficult to investigate than the elementary activities is a disadvantage which these authors believe is of comparatively small importance, since in the "superior psychical faculties," to use their terminology, there are stronger individual differences, and hence the need of precision is not so great.

The method of 'mental tests' is that most available for present use, and, since the particular tests which have been proposed by others are considered by Binet and Henri to be inadequate, these authors give a long and detailed list of tests which they consider will bring to light the strongest individual variations, a knowledge of which in one individual will give a general idea of that individual, and serve to distinguish him from others belonging to the same class.

The tests are grouped under the following heads. I. Memory: (a) visual memory of geometrical design, (b) memory of sentences, (c) musical memory, (d) memory of colors, (e) memory of figures. II. Nature of mental images: (a) letter squares, (b) interrogation. III. Imagination: (a) passive imagination (method of blots and of abstract terms), (b) constructive imagination (development of a theme), (c) imagination of design (composition or completion of a picture), (d) literary imagination (construction of sentences using given substantives or verbs). IV. Attention: (a) duration of attention (series of reaction times or successive reproduction of lengths from memory), (b) range of attention (counting of metronome beats and execution of several simultaneous acts). V. Faculty of comprehension: (a) talent for observation (analysis of a machine), (b) fineness of discrimination (discrimination of syno-

nyms and criticisms of sentences). VI. Suggestibility: (a) of sensations and perceptions (identification of lines and perception of odors), (b) of imagination (expectant attention), (c) of emotivity (apprehension, fear), (d) of involuntary and unconscious movements. VII. Æsthetic sentiment: (a) preference in geometric forms, colors, perfumes, (b) questionnaire. VIII. Moral sentiments (method of pictures). IX. Muscular force and strength of will (persistence in muscular effort). X. Motor skill and sureness of eye.¹

The general conditions which the proposed tests must fulfill are given by the author as follows. They should be simple, that is, they should require little apparatus; the time for the whole number of tests should not exceed an hour and a half for one individual; they should be varied in such a way as to avoid fatiguing the subject; and the means of determination should be as independent as possible of the personality of the experimenter, in order that the results obtained by one experimenter may be compared with those of another.

A casual reading of the descriptions given of the various tests will convince one that the first condition is fulfilled. The apparatus required are small as to number and simple in character. In regard to the requirement of time, however, the result is not so satisfactory. One test alone, that of the memory of sentences, of a progressively abstract character, could take scarcely less than a quarter of an hour: add to that the ten or fifteen minutes allowed for the development of a theme for constructive imagination, and it will be seen that the time is going far too quickly to allow an application of even a majority of the remaining tests. This fact has a bearing also on the next requirement, that there should be as great a variety as possible in the tests in order to avoid the disturbing effects of tedium and fatigue; for, although a certain variety in the experiments is advantageous for keeping up the interest of the subject, yet a crowding of many dissimilar tests into a brief space of time is equally disadvantageous. The aim is, of course, in these experiments to have the processes tested as nearly like those of every-day life as possible, and a monotonous repetition of exactly similar operations would defeat this aim. There is, how-

¹A number of these tests were applied by Dr. É. Toulouse in the psychological part of the investigation of which M. Émile Zola was the subject. The whole investigation is described by Dr. Toulouse in his book *Enquête médico-psychologique sur les rapports de la supériorité intellectuelle avec névropathie*. Paris, 1896. Inasmuch as the psychological tests employed are not the main reliance of the investigator in the formation of his judgments, but are considered only as giving confirmation to the judgments based on general observation of the subject, of his written works, etc., the essay can scarcely be called a purely experimental study of Individual Psychology.

ever, in every-day life, as the mind turns from the performance of one set of operations to another, a certain period of preparation. If the attention is, as it were, wrenched from one sort of activity to another very different sort, without any preparation, confusion is apt to ensue. So in the activities experimentally controlled, too sudden changes do not conduce to the most favorable conditions of the attention. In the tests laid down by Mm. Binet and Henri, therefore, the requirement of variety in arrangement is a just one, for the attention demands a frequent change of object. A radical change of object, however, requires time for the readjustment of the attention to the new conditions; and time must, therefore, be provided in sufficient measure. As much effort is expended and consequently as much fatigue is produced by working hard as by working long; it is poor economy to save time at the expense of effort. The chief reason why Mm. Binet and Henri make the requirement of brevity for the tests is the practical difficulty of securing the subject of experimentation on more than one occasion. This difficulty does not seem to be an unsurmountable one, as it probably would apply only to a restricted number of cases. When such cases do occur, judgment must be exercised in balancing the rival claims of variety or range of tests and of sufficient time to perform the tests most efficiently.

Whether the last requirement is fulfilled, whether, that is, the results of different experiments using these tests are perfectly comparable, is a question which can be decided only upon a further consideration of the individual tests. Owing to the complex material which is investigated, it is easy to see that this condition is a hard one to comply with perfectly. M. Binet treats of this subject in a separate article, *La mesure en psychologie individuelle*.¹ There is a quantitative aspect to most of the experiments, and this may be measured with a fair amount of accuracy. There are two possible methods of measurement, the first being a measurement of the results obtained while the test remains the same. Thus in memory, for example, accuracy may be measured by the amount by which the reproduced series falls short of the original series. The rapidity with which a certain amount of work is performed may measure some other processes. Enumeration and evaluation may also give numerical results, but of much less precise a character. The second method of measurement consists in a graduation of the experiment, the results being reduced to a maximum of simplicity. An example of this method would be, finding the maximal number of objects which a subject could retain after looking at them for five seconds. First three objects are shown,

¹ *Revue philos.*, Vol. XLVI, Aout, 1898.

then four, then five, etc., until the maximum is reached. The gradation of tests in terms, not of number but of kind, is difficult, as, *e. g.*, where sentences become more and more abstract.

M. Binet states that the measurement of which he is speaking is not a physical or absolute measurement, but only a method for the classification of individuals. There is no fixed standard by reference to which all individuals may be evaluated; but of certain specific individuals one can say that under certain fixed conditions, when A's memory of isolated words is 12 and that of B is 6, A's memory of isolated words is better than B's. It would be unwarranted, however, to say that A's memory for isolated words is exactly twice that of B, since all the words may not have the same value for consciousness.

All methods of measurement have for their aim the classification of all the individuals tested according to a quantitative scale. The tests, however, bear another aspect beside that of quantity. Quality must also be considered; and here it is necessary to class individuals according to different categories. M. Binet does not go into detail in regard to the possibilities of such a classification, but he suggests that the tests might differentiate literary and scientific types, or emotive (moral or egoistic) types.

PART II. EXPERIMENTAL.

§ 4. *Description of Tests.*

The following experiments were undertaken during the academic year '97-'98 as a study of Individual Psychology based, in general, upon the theories, and to a large extent upon the specific suggestions of Mm. Binet and Henri, as contained in their article *La psychologie individuelle*. The theory was provisionally accepted that the complex mental processes, rather than the elementary processes, are those the variations of which give most important information in regard to the mental characteristics whereby individuals are commonly classed. It is in the complex processes, we assumed, and in those alone, that individual differences are sufficiently great to enable us to differentiate one individual from others of the same class. Many of the particular tests recommended by the French psychologists were also adopted, but were considerably modified in the general conditions of their application by the purpose of our own investigation.

The aim of this work was (1) to ascertain the practicability of the particular tests employed, and (2) to answer the more general question as to the tenability of the theory upon which they are based, in so far as this can be judged by the experiments. In other words, we desired to assure ourselves whether

investigations of this kind enabled us to advance, at least, toward a solution of the problems of Individual Psychology; whether those individual variations, and those correspondences which are necessary for classifying individuals, and for estimating the relative importance of the several processes in a single individual, could thereby be discovered.

In view of these aims, and also of the criticisms of the general conditions demanded by Mm. Binet and Henri for the application of the method of 'tests,' the procedure was necessarily different from that laid down by these psychologists. To make sure that the tests give real individual differences, and not chance variations, it is necessary to apply them to the same individuals, not once, but several times, in order that it may be observed whether the variations in the different individuals maintain a constant relation to one another at various times and, consequently, under varying subjective conditions. Instead of single tests, therefore, series of similar tests for each activity were arranged. This necessitated, of course, a very large extension of the time beyond the limit allowed by the French investigators. The advantages of a short period of varied experimentation were, however, to a large degree attained. The experimental work of each subject was divided into periods of one hour each, and separated by intervals of one week. Within a single hour-period the tests were varied as much as possible. As a rule, only one or two experiments belonging to the series of a particular test were given.¹ In this way the tedium and fatigue due to monotonous repetition of similar operations were avoided, and a fair degree of interest in the work was maintained by the subject. The additional precaution was taken of separating by intervals longer than a week the experiments which were found to be especially trying or disagreeable to the subjects; as, *e. g.*, the development of a theme, or description of a scene or event, employed as a test for constructive imagination.

Since the experiments were of this detailed character, the number of subjects was necessarily restricted. The fact that the investigation was for the purpose of dealing with variations in individuals of *the same class*, afforded a further reason for this restriction. The subjects consisted of seven advanced students in the Sage School of Philosophy, three men (B, E. R., and W. M.), and four women (T, G, V. M., and L. R.), all of whom had had training in introspection. In the experimental work the subjects were divided into three groups; two groups of two subjects each, and a third group of three sub-

¹ Tests of memory for figures, words and letters, were exceptions to this rule.

jects. This arrangement was made owing to the fact that a large number of the experiments could be performed as readily by two at a time as by one. A group of three presented some difficulty to the experimenter, but not of a serious nature. As a rule, the system of grouping worked well, and caused much saving of time.

Certain of the tests which are especially adapted for collective study were given not only to these groups, but also, by the aid of Prof. Titchener, to the less advanced students taking the undergraduate (junior year) course in Experimental Psychology. The first ten minutes of the lecture hour were usually devoted by Prof. Titchener to this work, the test in every case being conducted by him. Occasional failure of attendance on the part of some members of the class causes a corresponding incompleteness in these results. They are useful, however, as allowing comparison between the less and the more completely trained students.

Though the tests as above described are intensively of greater range than those of Mm. Binet and Henri, they are extensively much more restricted. Only those tests were retained which have to do most directly with the intellectual activities. The æsthetic sentiments were touched upon in a very tentative manner in our investigation, while the moral sentiments, strength of will, etc., were either left out of account altogether, or entered only indirectly as results from tests which were applied primarily for a different purpose.

We are now ready to consider the tests in detail.

I. *Memory.*

1. *Memory of Letters.* Twenty sets of 12 letters each were prepared. As the object was to test the memory for isolated characters, it was desirable to avoid the formation of syllables by successive letters, in so far as this could be done without the total banishment of vowels from the series. The apparatus employed was Jastrow's Memory Drop, by means of which one letter at a time might appear before the eyes of the subject from behind a small opening in a screen. The movements of the drop must be made by hand; the experimenter regulated them by making them coincide so far as possible with the beats of a metronome marking intervals of one second. Each letter, therefore, was exposed to the view of the subject for approximately one second. The experiments took place in this way. The subject was seated at such a distance from the screen that the letters could be clearly seen. A series of twelve letters was then exposed, one by one, as above described. The subject was required immediately to recite the twelve letters in their order. If any mistake was made, the experiment was repeated; the letters being again exposed, and the subject again required to recite them correctly. This whole operation was repeated until the subject was able to name the twelve letters without error. The number of times it was found necessary to expose the series was noted. The answers to questions put by the experimenter in regard to the manner in which the letters were memorized,

as well as observation of the results of the various repetitions, gave information in regard to memory type, and therefore served to supplement the results obtained from another test, the purpose of which was the discovery of the nature of the subject's mental images.

This experiment differs from many others which are to follow, in that it could be performed with only one subject at a time; and also in the fact that several sets of similar series of letters were given to the subject in a single hour.

2. *Memory of Figures.* This test is almost precisely similar to the one above. The chief differences result from the fact that with figures the available characters are fewer, and hence in a series of twelve there must necessarily be some repetitions. Further, the figures, unlike letters, no matter how arranged, make an intelligible combination. The tendency to continue the separate figures is hindered somewhat,—in cases, almost entirely,—by the manner in which they are given successively; but in so far as the tendency to combine is exhibited, it shows an approach toward the memory of ideas. In the preparation of the series of figures it was our aim to avoid putting any two figures in their natural or inverted order, or immediately repeating the same figure. The experiment was conducted in the same manner as that described above.

3. *Memory of Words.*¹ This test has two parts. In the first place the experimenter read a series of 7 disconnected words, at the rate of about two words a second, and the subject was required immediately to recite these in order. If any word was left out of this recital, it was named by the experimenter, and any error was corrected. A second series of 7 words was then read, and the subject was required to recite them as before; then a third series, and so on, until seven series of seven words each had been read and recited. For the second part of the experiment the subject was required to name, in the order in which they occurred to him, as many as possible of the whole 49 words. In the first case one had immediate memory of verbal sounds; while in the recapitulation, which occurred at an interval of at least three minutes from the time of reading of the first short series, the auditory memory of the words had had time to be dimmed, and the sense of the words became a more important factor for memory. The difference in number of words remembered when taken series by series, and when taken as a whole, indicates the relation which subsists between the immediate memory and the memory of conservation in the individual tested. Four sets, each containing 7 short series, were given to all our subjects. The conditions of this test, also, required that one subject should be taken at a time.

4. *Memory of Sentences.* There were given two types of experiments under this head; (a) one in which the passage to be remembered was confined strictly within the limits of a single period, and (b) another, in which the passage was longer, comprising in some cases two, three, or even more sentences. For convenience, we may term the first type that of short sentences, and the second that of long sentences. All the sentences, both long and short, were graduated into five series, according to their degree of abstractness. This graduation was more or less arbitrary. It was difficult to define five distinct degrees; it was occasionally a matter of some little doubt, therefore, which of two successive degrees should claim a particular sentence. Although, however, the difference in abstractness between one degree and the next was often slight, the difference between the extremes of

¹ See A. Binet et V. Henri. *La mémoire des mots. L'Année psychologique*, Vol. I, 1894, pp. 1-24. Also E. Toulouse. *Enquête médico-psychologique sur les rapports de la supériorité intellectuelle avec la névropathie. Émile Zola. 1896.*

the series could not pass unnoticed. The following series of short sentences will serve as illustration :

I. A huge fire of logs blazed on the great kitchen hearth, and, at a table covered with maps and papers, neatly set in order, the general sat writing.

II. The Chinese regard us as strictly just and truthful, and it is only when we disabuse them of that impression that they show us any disrespect.

III. Whatever comes from the brain carries the hue of the place it came from, and whatever comes from the heart carries the heat and color of its birthplace.

IV. If the Necessitarian doctrine be true, then there is not merely no foundation either for morality or religion, but no basis either for divine or human law.

V. Thought is necessary to make even feeling or sensation to be conscious feeling or sensation; and thought can take place only through discrimination, or perception of difference.

The sentences were chosen from literature: magazine articles, novels, essays, and philosophical works. Fenimore Cooper, Carlyle, Huxley, Leibniz, and many others furnished their quota. Of the short sentences there were twenty sets of five series each, making one hundred sentences in all, ranging from 22 to 28 words in length. Two sets, only, of the long sentences were employed, making ten sentences, ranging from 51 to 64 words in length. All the sentences, both long and short, were given to the seven advanced subjects, while ten sets of short and the two sets of long sentences were given to the juniors.

The experiment was performed in this way. A short sentence was read aloud to the subject at the rate of about three words in two seconds, care being taken that all words should receive, so far as possible, equal emphasis. The subject was required to write down the sentences immediately after the reading. One set of five sentences was usually given to the advanced subjects in a single experimental hour. Sometimes two, and sometimes three sentences were given to the juniors at one meeting of the class. The subjects were requested, after writing the sentence, to underline *once* those words which they felt sure were remembered correctly, *twice* those words of which they were doubtful, and *three times* those words which they felt pretty confident were different from the words dictated. When words had completely fallen out of consciousness, the subjects left *spaces*, the length of which indicated the supposed gap in memory. The sentences were 'marked' under four headings: (1) verbal accuracy, that is, the number of words correctly remembered; (2) order, that is, the number of words occupying their proper position in the sentence; (3) sense, that is, the number of words which, either from the fact that they reproduced those in the sentence read, or that they were essentially synonymous with them, preserved the sense of the original sentence; (4) certainty of memory, that is, the number of words which were marked very doubtful (underlined three times) plus one-half the number of words which were marked somewhat doubtful (underlined twice). All these estimates were reduced to percentages, that the results of all the short sentences might be comparable. This system of marking has its disadvantages, as it depends in some degree upon the personal judgment of the marker. Especially is this the case with regard to the sense of sentences. Substitutions or errors in comparatively unimportant parts of a sentence may change the meaning slightly, but not essentially; still, the sentence can hardly be classed in such a case as reproducing perfectly the sense of the original sen-

tence. As all the sentences, however, were marked by one person, the error throughout is a fairly constant one, and the results obtained from different individuals may be, with justice, compared. The long sentences were intended to conform more nearly to those employed by Mm. Binet and Henri,¹ in the investigation briefly described above in Part I, with the exception that our sentences were graduated according to degree of abstractness. Their method of estimating the results was likewise followed. Each sentence was divided into groups, each group containing one important word with, perhaps, some subordinate words linking it to the rest of the sentence, that the number of groups might coincide with the number of ideas. The necessarily somewhat arbitrary character which this division assumes was before noticed, and is, of course, inimical to precision in results. The points noted in the results were: (1) number of the groups in a sentence which were retained intact; (2) number of words completely forgotten; (3) number of synonyms employed; and (4) number of other substitutions. It should be said that the test of long sentences was conducted in a similar manner to that of short sentences, the only difference being in the reading. No effort was made to have the reading monotonous, but every word was given its normal emphasis and inflection.

5. *Memory of Sounds.* To make a detailed test for memory of sounds would have required an amount of time for preparation and for experiment which it was impracticable to give in this investigation. We were content, therefore, with propounding to the subjects certain questions in regard to the readiness and accuracy of their musical memory. They were as follows:

1. Can you carry an air at all?

2. Can you reproduce an air after hearing it once? In your head? By whistling or singing?

3. How accurate is this reproduction (if it has been tested)?

This test was applied both to the advanced students and to the juniors.

II. *Mental Images.*

1. *Letter Squares.* This test was one described and recommended by Mm. Binet and Henri. White cards were prepared, three by four inches in size, and divided by black lines into twelve equal squares, each square containing in its center a large printed letter. As the longer side of the card was taken as the horizontal, there were four letters on a horizontal line and three on a vertical. Ten different combinations of letters were chosen for these cards, to be used in ten different experiments. There were other cards, precisely similar to these, except that the small squares were left blank. The experiments were first conducted in this way. Each of the subjects had before him, on the desk or table, right side up, a card of blank squares, and also, face downward, a card containing the printed letters. The requirements of the experiment were explained to him. Upon the signal of the experimenter he should turn up the printed card, and learn the letters and their respective positions in the squares. Twenty seconds were to be given for this. At the second signal of the experimenter, the subject should turn down the printed card, and proceed immediately to reproduce the letters upon the blank cards in their proper places. The subject was further requested to write on the reverse of the (originally blank) card the nature of the

¹ A. Binet et V. Henri. *La mémoire des phrases.* *L'Année psychologique*, Vol. I, pp. 24 ff. See also *La psychologie individuelle*, *ibid.*, Vol. II. The same type of test was used likewise by Dr. Toulouse in the investigation mentioned in a previous footnote.

mental images from which the reproduction was made. Five of the experiments were made in this manner: in the remaining five a modification was made in regard to the time. The subject was allowed only five seconds between the first and second signals for studying the letters. There was then an interval of thirty seconds, before the experimenter gave a third signal to fill the blank cards. This had the effect of making the introspection of memory images more easy. It also increased the number of errors; and, as Mm. Binet and Henri make the usefulness of the test to depend principally upon the study of the nature of the errors made, this fact is of importance. Like-sounding letters may be substituted for the correct ones, thus indicating the presence of auditory images; or errors may be traced to a similarity in form of the letters substituted, etc. The letters in the printed squares were arranged in a variety of ways. The last letters in each horizontal line occasionally rhymed, and in rare cases consecutive letters formed syllables.¹

2. *Questions.* Under this heading may be placed the information gained from the writing on the reverse of the blank cards, mentioned above, as well as that obtained in questioning the subjects in connection with the tests for memory of words, letters and figures.

III. *Imagination.*

1. *Passive Imagination.* (a) Method of blots. This test is also one mentioned by Mm. Binet and Henri, and is similar to that used by Dr. Dearborn.² The blots were formed very much after the fashion described by the latter writer. A drop of ink was allowed to fall upon a small Bristol-board card, and a piece of paper was placed over the card and rubbed with the finger. In this way a variety of forms were made on different cards; ten cards, in all, being employed. This test was applied to the advanced students only. A card bearing a blot was handed to the subject, who was requested to name all the objects suggested by the form of the whole blot or of any part of it. He was allowed to turn the card about in any direction. The objects suggested were written down by the subject. Five minutes were allowed for this experiment. The number of objects seen in the blot, their kind, and the manner of reporting them, gave information in regard to the passive imagination of the individual tested.

(b) Associations with Abstract Terms. These experiments consist in interrogating the subject as to what he represents to himself when such words as 'force,' 'infinity,' 'justice,' etc., are said, and also as to his possession of number forms or visual schemes for the arrangement of months, seasons, etc.

2. *Constructive Imagination.* (a) Mechanical imagination. Two tests were used for this: a German toy called the "Magic Box," and a 'puzzle' watch. The magic box was a box of tin about 3 inches in diameter, through the center of whose lid projected the tip of a magnetized revolving rod, actuated through an internal mechanism of gears and fly wheel by a thrust on an arm projecting through the side of the box. A small triangular piece of tin with rounded corners, to which could be attached paper dolls or animals, would, of course, if put upon the cover of the box near the rod, be drawn around as the magnetized pivot revolved. This toy was shown to the subjects, as well as the method of starting the motion by pushing the projecting

¹ One set of letters was taken from the example given by Mm. Binet and Henri. Three others were copied from those used by Dr. Toulouse. Certain errors on the part of the printer made slight changes in these latter, however.

² G. Dearborn. *Psychological Review*, May, 1897, pp. 309 ff. Cf. the same author, *A Study of Imagination*. *Am. Jour. of Psychology*, Vol. IX, pp. 183 ff.

arm; but they were requested not to handle the toy. The requirement made of the subjects was to explain the mechanism causing the movement of the tin standard around the cover of the box. The two points in the explanation should have been (1) the magnetic connection between the revolving rod and the tin standard, and (2) the particular internal mechanism by which the revolution was initiated and maintained.

In the puzzle watch the works were confined within a small crescent-shaped portion of the cylindrical space, while the rest of the watch, except the nickel rim, was completely transparent, having glass faces front and back. All that could be seen in looking through this portion was the hands, the rod on which they were carried, and the gilt numerals on the glass dial-plate. There was, therefore, no visible mechanical connection between the hands and the works. The subjects were required to explain the movement of the hands. This was caused by the revolution of an inner glass plate held in a toothed metal ring. Both in this experiment and in the one above the subjects were given five minutes for a written explanation, but an extension of time was granted if desired. These tests were carried out with the advanced students only.

(b) Literary Imagination. Three kinds of experiments came under this head: (a) the construction of sentences, (b) the development of a given theme, and (c) the choice of a topic for composition. The construction test was performed in this way: Three substantives or three verbs were read to the subject, and he was required to write in five minutes as many and as varied sentences as possible, embodying in each the three words given. Ten experiments with substantives, and ten with verbs were tried with each of the advanced students. The same number of experiments was given to the Juniors, but there was a modification in the time requirement,—only two minutes instead of five minutes being allowed for the composition of the sentences. In order, however, to have results directly comparable with those obtained from the advanced students, two tests with substantives and two with verbs were also given to the Juniors, in which five minutes were allowed for the composition of the sentences. In each case the number and quality of the sentences were noted. For the next test, that of the developing of a theme, two sets of topics were chosen, one set for narration or description, and the other for exposition. Ten minutes were given for writing. Three topics for narration (or description) and three for exposition were given to all¹ the advanced students. The third test consisted in naming ten titles for essays, five coming under each of the above named classes, and requiring the subject taking the experiment to choose from the ten given the five upon which he would prefer to write papers, provided that such writing were demanded of him. The topics given for test (b), development of a theme, were the following: (1) For imaginative treatment: "Capture of a Fortress," "The Escape of a Prisoner," and "A Forest Fire." (2) For exposition: "The Delays of Justice," "The Influence of Newspapers," and "The Mission of Music." The topics given for test (c), choice of titles, were these: "In a Snowstorm," "A Polar Landscape," "A Puritan Sabbath," "My Opposite Neighbor," "Man Endowed with the Power of Flight," "Civilization not Regeneration," "Wisdom in Charity," "Friendship of Books," "Fiction as a Vehicle of Truth," and "The Eloquence of the Bar and that of the Pulpit." A sort of modification of the last two tests was given to the Juniors. On two occasions they were granted a choice between two titles (one of each type), from which they should sketch out a plan for an essay. The

¹ With the exception that W. M. failed to take one of the topics for exposition.

time allowed for this was five minutes. The topics submitted on the first occasion were: "The Capture of a Fortress" and "The Friendship of Books;" on the second occasion, "The Escape of a Prisoner" and "The Influence of Newspapers." The length of the written compositions, their manner of development, the kind of topic chosen, and the character of the plans made for them, are sources of information as to the imaginative type of the individual. Further information was sought by general questions in regard to individual tastes and tendencies, such as the favorite reading of the subject, his fondness for reflective games, the theater, opera, etc.

IV. *Attention.*

1. The *degree* of attention habitually exercised by an individual was measured by the quickness and accuracy with which a certain given task was performed. The task chosen for this purpose was the cancellation of every letter *a* from the words of a printed page. In order that the operation might not become too mechanical, the subject was sometimes requested to cancel the letter *e* instead. Proof pages (12 mo.) of the English translation of Külpe's "Introduction to Philosophy" were used for the cancellation, the pages averaging about 350 words. At a signal from the experimenter the subject began reading to himself at a normal rate, crossing every *a* as it came to his notice, but never going back to cancel those overlooked when they were first passed over. As soon as the page was finished the subject gave a signal. The experimenter was thus enabled to read from the stopwatch the time required for the cancellation. The number of errors was afterward determined. Eight pages were thus submitted to each of the advanced subjects for experiment; but, as the subject matter was a possible means of distraction from the work of crossing out *a*'s, other printed pages of a different character were also used. One page of concrete description (376 words) was prepared and printed without the use of punctuation, spacing or capitals. Another page of philosophical matter (340 words), a page of disconnected words, and a page of 'pied' matter, were printed in the same manner. Copies of these pages were used for experiments in the same way as those described above. In the Külpe proof all the subjects had different pages, while in the other tests the copies were exactly similar for each kind of page. In the latter case, therefore, results from the different subjects were immediately comparable, since no complication could arise from difference of subject matter. All the subjects cancelled the *a*'s from eight pages of proof, one page of concrete matter, one page of abstract matter, two pages of disconnected sentences and one page of 'pied' matter.

A further experiment upon the degree of attention was tried with the seven advanced subjects by requiring them to read aloud, first, a page of concrete description, printed without punctuation, capitals or spacing; and, secondly, a similar page of exposition of abstract thought. The time necessary for each reading was noted, as well as the correctness of the words and expression. The first page consisted of a description of the situation and equipment of a blockhouse upon a densely wooded island. The most notable feature of this page was the frequent occurrence of monosyllabic words; while that of the second or abstract page consisted in the repetition of certain words, such as 'subject,' 'object,' 'relation,' 'absolute,' 'power,' 'force,' etc. The first page was slightly longer than the second, the number of words being 376 and 340 respectively.

2. *Range of Attention.* To test the subjects in regard to range of attention, a single experiment was tried in conformity with that sug-

gested by Mm. Binet and Henri. The subject was required to read aloud with normal rapidity and expression a passage of ten lines from a contemporary novel. The time taken by this reading was noted. The subject was then requested to read the same passage in precisely the same way as before, but while doing so to write on a sheet of paper beneath his hand the letter *a* as many times as possible. Again, the subject was requested to reread the passage, this time writing *a b* repeatedly. During a fourth reading, *a b c* were the letters required to be written. A fifth and last reading was then requested, during which the subject should write as far down the alphabet as he could without altering his reading; while if the alphabet were completed and time still remained, he should begin again at *a* and write as before. The chief difficulty in this experiment was in maintaining a uniform rate in the reading throughout the five tests, for the tendency in almost every case was to lengthen the reading in those tests which involved the simultaneous writing of letters, thus allowing time for a rapid oscillation of the attention from one set of acts to the other, and destroying their simultaneity. Where success was attained, however, in keeping the reading unchanged, the number of letters of the alphabet written by the subjects gave information in regard to individual differences in ability to perform practically simultaneous acts and thus in range of the attention; while in the cases where there was a decided lengthening of the reading during the performance of writing, this very fact was an indication of lack of such ability.

V. *Observation; Discrimination.*

This corresponds to the heading termed by Mm. Binet and Henri the 'faculty of comprehending,' and comprises phenomena known under various names, such as *talent of observation, keenness of mind, good sense, judgment*, etc., owing to the difficulty of precise definition. By it is meant the power to perceive relations, to distinguish the real and essential from the apparent and accessory; the ability to analyze and systematize. The lack of analysis of the processes involved makes exact investigation impossible, but certain tests have been adopted which are calculated to throw light upon the individual differences in this aspect of mind. Of these tests, the first two—those which have especially to do with observation—may be classed also as tests of memory; but since the memory is immediate, while the time of observation is very short, the individual differences seem to be attributable to the latter rather than to the former. The first test was applied after this manner. The reproduction of a picture, cut from a magazine, with the title carefully trimmed off, was shown to the subject for a period of thirty seconds, after which he was requested to write out a full description of what he saw, five minutes being allowed for the writing. This experiment was tried upon all the advanced students with two different pictures. The first picture, entitled the "Golden Wedding," was more satisfactory than the second, "An Interrupted Duel," in that it contained far more variety of detail, more unmistakable feeling, and somewhat greater scope for difference of interpretation. Both pictures, however, contained more detail than could be exhausted by an attentive observation of thirty seconds. This test is very similar to that described by M. Binet in his article *La description d'un objet*,¹ the chief difference being that the picture—in this case exposed to the observation of children—represented a scene from a familiar fable, and the subjects were so informed before looking at it. The time of observation was two minutes, instead of thirty seconds.

¹ L'Année psychologique. Vol. III, pp. 296 ff.

The results from this test, as from those of imagination, seem to be mainly valuable as indicating certain individual types.

The second test under Observation is similar to the first and may be briefly dismissed as having in itself small value. A small colored card, representing a lady rather brilliantly dressed standing before a dressing table upon which reposed variously tinted bottles and boxes, was shown to the subject for the space of five seconds, after which he was requested to write down all the different colors he had observed on the card, together with the location of each. This test, like the first, may be reckoned one of observation rather than of memory, since the colors of the pictured card were not that to which attention would naturally be primarily directed; moreover, the colors were few and could easily be remembered if noticed. Hence the number of colors actually remembered was an indication of the degree in which they attracted the attention of the observer. Since, however, the experiment was given but once, the result could not be taken as showing a permanent attitude of mind.

The third test departed entirely from the sphere of sensible perception, and had to do with thought relations. A pair of synonyms was given to a subject, and he was allowed five minutes for writing down the distinction between the words in regard to their meaning and use. Six pairs of such words were given to the Junior class and seventeen to the advanced students.

VI. Taste and Tendencies.

Under this heading are grouped the remaining experiments, the object of which was to test in the several individuals the appreciation of the beautiful as expressed especially in art, music, and literature. In these tests the assumption is made that the taste for an art will carry along with it a knowledge of that which is universally conceded to be the best work in that sphere, as well as some knowledge of the authors of it. This seems to be a warrantable assumption, if we take into consideration the individuals tested; since all must have had opportunities (college libraries, magazines, etc.) to learn of that toward which their natural tastes directed them. Art, music, and literature form the basis for the investigation; art being taken in the restricted sense as comprising painting and sculpture.

1. *Art.* Three tests belong here. (a) For this test, a selection of twelve paintings was made from among those which are given the very highest place in that art. Photographic reproductions of these were used. A subject was given a photograph, and allowed five minutes for noting in writing five things: title, artist, school, and approximate date of the original, together with a brief description from the photograph itself. The paintings chosen were these: Raphael's *Sistine Madonna*, Michael Angelo's *Last Judgment*, Leonardo da Vinci's *Last Supper*, Rubens' *Descent from the Cross*, Correggio's *Holy Night*, Titian's *Assumption of the Virgin*, Murillo's *Immaculate Conception*, Rembrandt's *Night Watch*, Volterra's *Descent from the Cross*, Guido Reni's *Beatrice Cenci*, Velasquez' *Portrait of Himself*, and Guido Reni's *Aurora*. These photographs were given not only to the advanced subjects, but also to the members of the Junior class. As there was but one photograph of each painting, and as the time available was not sufficient to allow five minutes for considering each photograph, the experiment was performed upon the Juniors in this way. Each photograph was numbered upon the back, and all were distributed among the class, face downward. The experimenter then gave instructions, reading the questions (given above) to which answers should be written. A signal was then given: the subjects wrote

down at the head of a sheet of paper the number on the back of the photograph. Another signal, and the photographs were turned, and one full minute allowed for writing the answers. Then the photographs were passed on, from each student to the next, and the signals were repeated as before.

Tests (b) and (c), given to the advanced students only, consisted in allowing five minutes each for the subject to write (b) the names of as many noted pieces of sculpture as possible, and (c) the names of as many artists renowned in the sphere of painting or plastic art as could be written in the given time.

2. *Music.* Here the tests are similar in nature to those above. (a) The subject was required to name, on paper, as many musical composers of renown as possible in five minutes. (b) The subject, being given a list of ten musical composers, was required to name one composition or important class of composition produced by each. Five minutes was the allotted time for this also. The list of composers comprised the following: Mendelssohn, Beethoven, Chopin, Mozart, Wagner, Liszt, Schumann, Rubinstein, Handel, and Schubert. (c) The test previously described under the partial memory of sounds (power to remember and reproduce musical airs) has a bearing upon this part of our subject.

A modified form of these tests was given to the Juniors. They were required to write (1) a list of six musicians, (2) one production under each name, (3) the style of each, *i. e.*, his favorite form of composition, and (4) to answer the question: "What did Wagner introduce into Grand Opera?"

3. *Literature.* (a) Selections were chosen from eight prominent English prose writers, and read aloud to the subjects. After the reading of each, the subject wrote whom he considered to be the author of the selection, as well as the source of this judgment: whether memory of the particular passage, or inference drawn from the style or subject matter. The writers and selections were as follows: Macaulay, *The Progress of England*, from *Essays on Sir James Mackintosh*; Ruskin, *The Open Sky*, from *Modern Painters*; Bacon, *Of Studies*, from the *Essays*; Dickens, *Mrs. Gamp's Apartment*, from *Martin Chuzzlewit*; De Quincy, *A Wonderful Dream*, from *Confessions of an English Opium Eater*; Carlyle, *Labor*, from *Past and Present*; Thackeray, *Family Prayers*, from *The Newcomes*; and Scott, *Raleigh's First Interview with Queen Elizabeth*, from *Kenilworth*.

(b) Similar selections were chosen from eight English and American poets, and the test was performed in the same manner as the above. The subjects were informed that the poetry might be taken from either English or American writers. The passages selected were these: Wordsworth's *Ode to Immortality*, first two stanzas; Shakespeare's *Midsummer Night's Dream*, speech of Theseus on Imagination; Tennyson's *In Memoriam*, LIII; Milton's *Ode to His Blindness*; Browning's *Rabbi Ben Ezra*, stanza "Thou Fool!" etc.; Bryant's *To a Waterfowl*, last three stanzas; Holmes' *The Chambered Nautilus*, last two stanzas; and Spenser's *Fairy Queen* I, 4: 4, 5 (*The House of Pride*).

4. A further test of tastes and tendencies consisted in the questions put to the subjects as to the character of their favorite reading, their fondness for the opera, the play, and for reflective games such as whist, chess, etc. See above, under III.

§ 5. Results.

We have next to consider the results obtained from the tests that have been outlined. They may be considered from two

points of view, quantitatively and qualitatively. Some tests best lend themselves to a numerical expression of results, while the outcome of others must be estimated chiefly in terms of quality. Among the former are the tests of the first group, those upon memory.

I. *Memory.*

1 and 2. *Memory of letters and memory of figures.* These may be considered together, since the tests were closely similar and performed in the same manner.

TABLE I.

SUBJECTS.	MEMORY OF LETTERS.		MEMORY OF FIGURES.	
	Average times exposed.	Fluctuation limits.	Average times exposed.	Fluctuation limits.
B.	(2) 3	1—6	(3) 2.9	1—4
G.	(1) 2.25	1—4	(1) 2.25	1—3
V. M.	(7) 4.95	2—12	(6) 3.7	2—5
W. M.	(3) 3.2	2—5	(2) 2.6	2—4
E. R.	(5) 3.9	3—6	(5) 3.5	2—5
L. R.	(6) 3.95	2—7	(7) 4.55	3—9
T.	(4) 3.3	1—6	(4) 3	2—4

Table I gives for each individual (1) the averages, taken from twenty experiments each of letters and figures, of the times necessary to expose a series of twelve before it is correctly repeated, and (2) the fluctuation limits, that is, the highest and the lowest number of exposures required for the memorizing of one series by the different individuals. The small figures in brackets at the left of the first and third columns indicate the order of the averages from the lowest to the highest, or the order of the individuals in regard to rapidity of memorizing from the most to the least rapid.

A comparison of the results from the last five experiments with letter series with those from the first five makes evident the effect of practice. In the last experiments also, the individual differences decreased. In the figure series the effect of practice in the last experiments was less apparent. This was, no doubt, partly due to the fact that the practice gained in the memorizing of letters facilitated the memorizing of the figures from the first.

A glance at Table I will show a certain correspondence between the order of averages for letters and that for figures. Where changes have taken place, it is between those individuals whose averages were contiguous. Thus, 2 and 3, and 6 and 7 changed places, but there is no

indication of a strongly developed partial memory for either letters or figures alone, on the part of any individual, which would make a radical difference in the order of averages for the two kinds of experiments. The Table shows, in general, a slightly better memory for figures than for letters, with one marked exception (*L. R.*). Memory of figures might have been easier for several reasons. The practice mentioned above, gained from the similar memorizing of letters, the permanent practice gained in the course of education, and the fact that figures, in whatever order, make an intelligible combination, all would contribute to greater ease in learning figures. In the case that shows a decided divergence from this rule, the cause probably lies in the fact that the subject tried to rely upon her visual memory, and that, as there was necessarily a recurrence of some figures in a series of twelve, the repetition tended to fatigue the attention and confuse the mind of the subject in regard to the order of the characters. The decrease in the variety of form doubtless made the figure series harder to remember than the letters. The Table shows not only a lowering in the averages for memory of figures, but a lowering, in the case of every individual but the one above excepted, of the upper limit of fluctuation.

The mode of memorizing the letters and figures used by the subjects, as learned from observing them and also from their own reports, shows no coincidence between any particular memory type and any special ability or disability for memorizing.

3. *Memory of words.*

TABLE II.

SUBJECTS.	B.	G.	V. M.	W. M.	E. R.	L. R.	T.
Av. per cent. of words re-produced in short series.	(5) 81.1	(2) 84.2	(3) 84.1	(6) 77.5	(7) 75.6	(4) 82.2	(1) 98.5
Av. per cent. of words re-produced in recapitulation.	(2) 34.6	(1) 54.3	(5) 27.9	(3) 34.1	(7) 19.0	(6) 27.5	(4) 29.6
Difference.	(3) 46.5	(1) 29.9	(5) 56.2	(2) 43.4	(6) 56.6	(4) 54.7	(7) 68.9

Table II gives on its first line the average percentage of words of short series which were immediately repeated by the subject after the series was read to him. The percentages represent for each individual the results obtained from four sets of seven short series each. The second line of the Table gives the average number of words mentioned

by each subject in recapitulating from memory as many as possible of the whole forty-nine words contained in a set of seven series of seven words each. The averages in this line were also made from four sets of such series. The third line of the Table gives the average percentage of loss sustained by the memory in the time intervening between the repetition of the short series and the recapitulation. The first line, then, indicates individual differences in the immediate memory of verbal sounds; the second line, individual differences in the memory of conservation; and the last line, individual differences in loss.

The words used in these tests were of varied character, comprising names of particular objects, qualities, virtues, general and abstract terms, in wholly disconnected order. The results showed no marked individual differences in the kind of words remembered. A fair proportion of the abstract terms were remembered by all the subjects. In general, the position of the words in the original series gave no clue to individual differences in the recapitulations. The words in the first and last parts of the sets were usually those best represented in the recapitulations of all the subjects. In the case of *T.*, however, the tendency to remember best the words in the last short series was more marked than in the others.

Table II shows in the first line an order among the individuals quite different from that observed in the previous Table. *T.*, who there held the fourth place, here stands far higher than any other; and *V. M.* and *L. R.* change from the sixth and seventh to the third and fourth places. This change is largely due to the fact that the remembered stimuli are auditory instead of visual. In the short series it was chiefly a succession of sounds that was remembered, as is attested by the fact that, where mistakes by substitution occurred, they were almost invariably of like-sounding words, such as *flower* for *floor*, or *furnish* for *furnace*; while, in the recapitulation, the errors are usually additional words suggested from analogy of sense, such as *dog* suggested by *cat*, *cold* by *winter*, and *accident* by *horror*. In the recapitulation, the order among the individuals returns very nearly to what it was in the first two tests.

4. *Memory of Sentences.* (a) *Memory of Short Sentences.*

Table III gives under four headings the average percentages obtained from twenty sentences under each of the five groups. The sentences increase in abstractness from Group I to Group V. The average length of sentences under each group is given at the foot of the Table. The exact meaning of the four headings under which the percentages are classified has been before stated. The complete results from which these averages are drawn show for a single subject, in a single group of similar sentences (similar in regard to abstractness), fluctuations larger than the differences in the averages of widely separated groups. This is evidence of the complexity of the factors which enter into these experiments. The differences in the length of the sentences (though these are not large), the differences in construction, the use of words

TABLE III.

	GROUP I.				GROUP II.				GROUP III.				GROUP IV.				GROUP V.			
	AVERAGE PERCENTAGES.				AVERAGE PERCENTAGES.				AVERAGE PERCENTAGES.				AVERAGE PERCENTAGES.				AVERAGE PERCENTAGES.			
	Verbal Accuracy.	Order.	Sense.	Certainty.	Verbal Accuracy.	Order.	Sense.	Certainty.	Verbal Accuracy.	Order.	Sense.	Certainty.	Verbal Accuracy.	Order.	Sense.	Certainty.	Verbal Accuracy.	Order.	Sense.	Certainty.
B.	84.9	98.8	88.6	94.5	80.5	98.9	95.3	91.0	78.7	99.1	85.7	90.2	74.4	97.6	87.1	88.7	73.5	96.2	83.7	89.0
G.	93.5	99.0	96.4	98.3	94.5	99.6	99.6	97.5	88.3	99.8	97.0	98.2	87.3	98.4	95.8	97.1	92.1	98.8	99.4	97.4
V. M.	88.1	99.0	94.5	98.4	94.3	99.5	97.8	98.5	90.7	99.4	96.1	97.4	87.2	99.4	94.6	98.6	82.0	97.1	88.1	94.2
W. M.	84.5	98.4	90.6	97.8	87.8	98.9	90.4	97.5	85.3	98.6	86.8	96.5	83.6	99.3	92.2	96.5	79.4	98.4	86.8	97.6
H. R.	76.9	98.2	84.2	97.3	85.3	97.5	83.3	95.5	69.6	97.9	83.2	85.3	82.0	98.1	85.3	82.3	70.9	97.9	83.4	88.7
L. R.	88.4	98.6	93.5	95.5	89.5	99.7	97.5	96.8	84.6	99.2	91.5	93.8	73.2	98.3	93.8	94.0	81.3	98.4	81.2	92.6
T.	96.5	100.0	97.3	99.1	97.5	100.0	97.7	98.7	94.7	100.0	92.7	99.3	95.0	99.6	98.8	97.7	94.5	99.0	95.4	97.5
	Av. length of sentences = 24 $\frac{1}{2}$ words.				Av. length of sentences = 23 $\frac{1}{2}$ words.				Av. length of sentences = 25 $\frac{1}{2}$ words.				Av. length of sentences = 24 $\frac{1}{2}$ words.				Av. length of sentences = 24 $\frac{1}{2}$ words.			

which may chance to be somewhat unfamiliar to the subject, and, perhaps, more important than all, the varying subjective conditions under which the experiments are performed, produce results of more varying character than those which come from differences in the abstractness of the sentences. One page from the original results, chosen at random, will show the lack of constancy in the averages under any one group of sentences.

Specimen Page of Original Results.

SUBJECT B.

Sentences.	% Verbal Accu- racy.	% Order.	% Sense.	% Cer- tainty.	Sentences.	% Verbal Accu- racy.	% Order.	% Sense.	% Cer- tainty. <small>1</small>
1, III, 22	100.0	95.5	100.0	93.2	1, IV, 22	100.0	100.0	100.0	93.2
2, III, 23	83.1	100.0	69.6	93.5	2, IV, 22	77.3	100.0	86.4	95.5
3, III, 23	95.7	100.0	100.0	91.4	3, IV, 23	95.7	100.0	100.0	100.0
4, III, 24	87.5	100.0	95.9	95.9	4, IV, 23	95.7	100.0	100.0	97.9
5, III, 24	95.9	100.0	100.0	93.8	5, IV, 23	100.0	100.0	100.0	95.7
6, III, 24	62.9	100.0	75.0	100.0	6, IV, 23	67.4	95.7	91.4	93.5
7, III, 24	95.9	100.0	100.0	98.0	7, IV, 24	83.4	95.9	87.5	98.0
8, III, 25	50.0	100.0	78.3	96.0	8, IV, 24	83.4	100.0	83.4	93.8
9, III, 25	86.0	100.0	100.0	93.5	9, IV, 24	83.4	95.9	87.5	95.9
10, III, 25	84.0	100.0	84.0	98.0	10, IV, 25	40.0	92.0	72.0	74.0
11, III, 25	86.0	96.0	92.0	76.0	11, IV, 25	56.0	96.0	76.0	92.0
12, III, 25	80.0	100.0	100.0	90.0	12, IV, 25	56.0	92.0	56.0	76.0
13, III, 25	76.0	100.0	88.0	90.0	13, IV, 25	96.0	100.0	100.0	90.0
14, III, 26	79.3	100.0	100.0	84.7	14, IV, 25	92.0	100.0	92.0	96.0
15, III, 26	96.6	100.0	100.0	94.3	15, IV, 25	80.0	96.0	92.0	92.0
16, III, 26	80.8	100.0	84.7	98.1	16, IV, 25	77.0	96.6	100.0	100.0
17, III, 27	70.4	100.0	100.0	100.0	17, IV, 26	88.5	100.0	96.1	96.1
18, III, 28	82.2	96.5	96.5	92.9	18, IV, 26	61.6	100.0	96.1	94.3
19, III, 28	89.3	100.0	100.0	94.7	19, IV, 27	77.8	96.3	100.0	88.9
20, III, 28	92.9	100.0	100.0	100.0	20, IV, 28	57.2	96.5	85.8	91.2
Average	78.7	99.1	85.7	90.2		74.4	97.6	87.1	88.7

The results from sentences given to the Juniors show precisely the same characteristics, and hence will not be given here.

Table III shows that the columns headed *order* of words and degree of *certainty* of the subject indicate small differences between the individuals in these respects, although in the groups of the more abstract sentences individual differences in regard to the certainty of memory increase. Again, slighter individual differences are seen in *sense* than in *verbal accuracy*, the former being very frequently preserved when the latter is at fault. Considering, then, the verbal accuracy alone, we find, except in the case of one subject, that there is no constant lowering of the percentages as the sentences become more abstract. Between contiguous groups of sentences, where differences in concreteness or abstractness are slight, the length of the sentences appears to have a

decided influence. For example, all subjects but one (*B.*) have a higher percentage of verbal accuracy for Group II, which averages shorter sentences, than for Group I; while in Group III, whose sentences average longer than those of Group I, there is a lowering of the percentages for verbal accuracy on the part of each subject. A just comparison of the individual differences in the different groups should, however, take into consideration all of the four headings for marking. It may be made from Table IV, which gives the averages of the four percentages for each individual under each group, as well as the general average from all the percentages of all the sentences.

TABLE IV.

	I	II	III	IV	V	General.
	%	%	%	%	%	%
<i>B.</i>	⁶ 91.7	⁶ 91.4	⁵ 90.9	⁶ 86.9	⁶ 85.6	⁶ 89.2
<i>G.</i>	² 96.8	² 97.8	³ 95.8	³ 94.7	¹ 96.7	² 96.4
<i>V. M.</i>	³ 95.0	³ 97.5	² 95.9	² 94.9	⁴ 90.4	³ 94.7
<i>W. M.</i>	⁵ 92.8	⁵ 93.7	⁶ 90.6	⁴ 92.9	³ 90.5	⁵ 92.1
<i>E. R.</i>	⁷ 89.1	⁷ 90.4	⁷ 84.0	⁶ 86.9	⁷ 85.2	⁷ 87.1
<i>L. R.</i>	⁴ 94.0	⁴ 95.9	⁴ 92.3	⁵ 89.8	⁵ 88.4	⁴ 92.0
<i>T.</i>	¹ 98.2	¹ 98.5	¹ 96.7	¹ 97.7	² 96.6	¹ 97.5

In Table IV several things may be noted. Every individual (except *B.*, whose I and II figures are practically equal,) attained his highest percentage in Group II, that which averages the shortest sentences. The position of the lowest percentages varies with the individuals. For *T.* and *W. M.*, this percentage is practically the same in Group III, which averages the longest sentences, and in Group V, which contains the most abstract sentences: a slight difference in lowness being in favor of the latter. For *E. R.* the percentage shows that it is Group III which is most difficult, while for *B.*, *V. M.*, and *L. R.*, it is Group V. The remaining subject, *G.*, has her lowest average, strange to say, in Group IV, which is intermediate both as to length and abstractness between III and V. For all subjects, however, the percentage in Group V is lower than in Group I, the amount of the difference varying in the individuals as follows: *B.*, 6.1%; *G.*, 0.1%; *V. M.*, 4.6%; *W. M.*, 1.3%; *E. R.*, 3.9%; *L. R.*, 5.6%; and *T.*, 1.6%.

In regard to the order in which the individuals stand in the different groups, as indicated by the small figures in the Table, it will be seen that no subject keeps the same order throughout. *T.* shows the greatest constancy. The subjects may, however, be grouped in a general way. *T.*, *G.*, and *V. M.* hold the first three places; *W. M.* and *L. R.* connect, and *B.* and *E. R.* last. This grouping agrees, too, with the order of results in the general averages.

If the order seen in the last column of Table IV be compared with that observed in Tables I and II,—that is, the order of the subjects in regard to memory of letters, figures, and words,—it will be found that the former approaches most nearly the order in the immediate memory for words. In the test of sentences, as in that of words, the stimuli were auditory impressions, to be reproduced immediately after dictation. In the case of sentences, however, the sense of the words had much more influence; for although the words were read by the experimenter very monotonously, as if they formed an unconnected list, and the interpretation was left to the subject, yet this, when made, could not but prove a material aid to the memory. For both these reasons the order is very different from that observed in the memory for letters and for figures, while only slightly different from that for the immediate memory for words.

Considering the test in general, it may be said that, in sentences of the length here used, abstract sentences are very little more difficult than concrete for any of the subjects (including the Juniors). Moreover, in regard to the availability of the test, the results shown are of too meager and indecisive a character to be at all in proportion to the time and labor necessary for the selection, classification and correction of the sentences.

(b) Memory of Long Sentences.

Table V gives in full the results, for the advanced students only, of the test of long sentences, where two sentences are given for each of the five degrees of abstractness. A word should be said in regard to the categories under which the marking is made. The number of words forgotten means only those which have entirely dropped out from the memory, those for which no substitution, even though inaccurate, is made. The number of groups retained embraces only those in which there is absolutely no change in verbal form. The 'number of synonyms' means the number of words in the original passage for which synonymous words or phrases are substituted. These substitutions may have a more contracted or expanded form than the original, but contractions are by far the more numerous. The fourth category, 'number of substitutions,' means the number of words in the original passage which are represented in the reproduction, but not with sufficient accuracy to be classed as synonymous substitutions, *plus* the words in the reproductions which have no counterparts in the original passage. Substituted forms may be words which mean something different from the original, although related to it by analogy; or they

may be whole sentences or parts of sentences which express fairly well the main idea of the original, while ignoring all minor points of significance, and with an entire change of syntax and verbal form; or, again, they may consist in the addition of words not found in the

TABLE V.

	A I. 52 words, 23 groups.				A II. 58 words, 15 groups.				A III. 64 words, 23 groups.				A IV. 52 words, 15 groups.				A V. 51 words, 21 groups.			
	No. of words forgotten.	No. of groups retained.	No. of Synonyms.	No. of Substitutions.	No. of words forgotten.	No. of groups retained.	No. of Synonyms.	No. of Substitutions.	No. of words forgotten.	No. of groups retained.	No. of Synonyms.	No. of Substitutions.	No. of words forgotten.	No. of groups retained.	No. of Synonyms.	No. of Substitutions.	No. of words forgotten.	No. of groups retained.	No. of Synonyms.	No. of Substitutions.
B.	15	12	0	12	21	7	0	6	25	2	0	22	21	3	0	14	17	2	15	7
G.	0	22	4	4	1	14	0	0	4	18	3	1	1	10	5	3	46	2	0	0
V.	8	16	5	2	8	3	14	4	16	8	11	11	23	3	11	17	17	3	11	6
W.	4	15	1	11	20	5	4	1	12	5	23	5	29	4	0	4	39	2	5	1
E.	13	16	2	6	10	1	3	32	12	1	3	40	6	1	10	23	14	3	5	20
R.	10	15	6	1	10	4	3	7	17	1	11	25	8	5	7	14	2	3	3	23
L.	10	15	6	1	10	4	3	7	17	1	11	25	8	5	7	14	2	3	3	23
T.	24	12	1	0	9	12	1	0	12	9	0	11	10	8	1	4	8	6	2	16
	B I. 55 words, 24 groups.				B II. 57 words, 17 groups.				B III. 63 words, 24 groups.				B IV. 59 words, 21 groups.				B V. 59 words, 21 groups.			
	No. of words forgotten.	No. of groups retained.	No. of Synonyms.	No. of Substitutions.	No. of words forgotten.	No. of groups retained.	No. of Synonyms.	No. of Substitutions.	No. of words forgotten.	No. of groups retained.	No. of Synonyms.	No. of Substitutions.	No. of words forgotten.	No. of groups retained.	No. of Synonyms.	No. of Substitutions.	No. of words forgotten.	No. of groups retained.	No. of Synonyms.	No. of Substitutions.
B.	16	10	4	7	10	8	4	10	30	10	2	4	7	10	1	11	4	6	7	28
G.	2	22	3	2	1	12	5	3	1	15	12	3	7	12	3	5	26	7	1	5
V.	7	19	7	3	9	11	6	6	19	6	4	3	9	5	6	20	32	5	1	6
W.	21	10	0	3	6	12	1	2	15	9	5	6	11	11	2	18	2	5	13	14
E.	16	13	3	3	9	12	3	26	33	9	0	20	11	2	0	18	0	11	11	36
R.	8	17	7	5	7	11	2	1	8	10	8	6	21	4	0	18	15	4	12	1
L.	8	17	7	5	7	11	2	1	8	10	8	6	21	4	0	18	15	4	12	1
T.	6	20	3	1	3	9	4	3	25	6	5	6	7	10	1	11	0	2	10	26
Totals	150	219	46	59	124	113	47	95	229	102	87	169	171	88	38	136	254	51	86	188

original. The latter kind is not of frequent occurrence. It will be seen that the Table does not represent the results precisely. It gives the number of words for which substitutions are made, but not the

number of words substituted ; neither does it tell just *how* closely the latter conform to the former in meaning. The four categories employed seem, however, to be those most practicable for marking the sentences employed in this test.

Table V shows that here, as in the preceding test, there is a considerable lack of constancy in the results. The memory of long sentences requires a high degree of attention on the part of the subject, and any accidental subjective condition which may serve to distract him will produce an effect on the results which no consideration of the objective conditions can account for. The same individuals show often a wide discrepancy of results between two sentences of the same degree of abstractness and of almost the same length and number of words. The totals, however, show here, as in the test with short sentences, that the most abstract sentences are more difficult to remember than the concrete. The total number of groups retained steadily decreases from I to V. The total number of words completely forgotten is considerably greater in V than in I, although in length the sentences do not greatly differ. In III, where the sentences are long, the number of words forgotten is almost as great as in V ; a result which also agrees well with that observed in the previous experiment. In general, the number of synonyms increases as the sentences become more abstract, and the number of substitutions increases in even larger proportion.

TABLE VI.

	Number of words forgotten in all the sentences	Number of groups retained in all the sen- tences.	Number of syn- onyms in all the sentences.	Number of sub- stitutions in all the sentences.
B.	6. 166	6. 70	6. 33	2. 121
G.	1. 89	1. 184	5. 36	7. 26
V. M.	5. 148	3. 79	1. 60	5. 66
W. M.	7. 179	4. 78	3. 58	6. 49
E. R.	4. 124	7. 45	4. 40	1. 224
L. R.	3. 118	5. 78	2. 59	3. 94
T.	2. 104	2. 93	7. 28	4. 78

Table VI shows a summary of results. It gives for each subject the total number of words forgotten, groups retained, etc. Individual characteristics here manifest themselves. For *B.* this characteristic is the large number of words completely forgotten, for *G.* the large number of groups accurately remembered, for *E. R.* the large number of substitutions ; while for the remaining subjects the number of words completely forgotten seems the most prominent characteristic.

Several things are to be noted in regard to the order as indicated by the small figures. The order in the number of groups retained is the same as in the general averages for memory of sentences, with the exception that *T.* and *G.* have changed their places as 1 and 2 respectively. It has been seen that *T.* excelled when immediate auditory memory was called into play. Here the sentences are so much longer than the preceding ones that the auditory memory has been forced into greater subservience to the memory of ideas, and hence the loss of rank follows. That the order in columns 1 and 2 differs considerably arises from the fact that, where groups are not exactly retained, they need not all be dropped out, but may be expressed, with more or less exactness, in a different verbal form. It is to be noticed, also, that the order in column 4 and that in column 2 are almost precisely reversed; that is, those who have retained the greatest number of groups have employed the least number of substitutions, and *vice versa*. All this throws some light upon the relative reliability of the memory in the subjects tested. *G.* shows not only the largest number of groups retained and smallest number of forgotten words, but also a preponderance of synonymous words over substitutions. *W. M.*, whose number of forgotten words is large, has also a preponderance of synonyms over substitutions. In all other cases the substitutions outnumber the synonyms. This is markedly the case for *E. R.*; *B.* shows the same characteristic in a lesser, but still large, degree. Both kinds of changes in expression result from what Mm. Binet and Henri call 'verbal assimilation.' The subject gives to a passage, as it enters his mind, the stamp of his own personality, imparts to it his own habits of thought.

5. *Memory of Musical Sounds.*

The responses to the three questions: (1) Can you carry an air at all? (2) Can you reproduce an air after hearing it once? In your head? By whistling or singing? and (3) How accurate is your reproduction (if it has been tested)?—have been tabulated for the advanced students as follows.

TABLE VII.

	Carry Air?	Reproduce after single audition.		Accurate?
		Mentally?	Physically?	
B.	Yes.	Seldom.	No.	Not tested.
G.	Yes.	No.	No.	Only after learning.
V. M.	Yes.	Often.	Partially.	{ Mental reproduction accu- rate. Physical, not.
W. M.	Yes.	Partially.	Partially.	Fairly accurate.
E. R.	Yes.	Yes.	Sometimes.	Not tested.
L. R.	Yes.	Partially.	Partially.	Yes.
T.	Yes.	Partially.	Partially.	Yes.

The memory for musical sounds cannot be compared with that for letters, figures, etc., since no direct test was given for the former. The answers above tabulated are, moreover, not sufficiently precise to warrant any exact comparison between the individuals in regard to the readiness and accuracy of their musical memory. All that can be said is that *B.* and *G.* appear to fall within a different group from the other subjects. That musical memory is something quite distinct from mere auditory imaging is shown by a comparison of *G.*'s line in this Table with the corresponding line in Table VIII.

II. *Mental Images.*

Letter Squares.—In this test the errors made are intended to form the basis of a judgment in regard to the kind of mental images employed by the subjects in their reproduction of printed letters. The largest error, however, lay throughout in incompleteness; that is, the omissions far outnumbered the actual mistakes. Again: the number of right letters placed in the wrong squares exceeded greatly the number of wrong letters, *i. e.*, of letters which did not appear on the printed card at all. The omissions are, for the most part, non-committal as regards mental images; the errors of position are often equally so; while the wrong letters used do not invariably make the kind of images a matter free from doubt. The subject's report of introspection, therefore, which accompanied each experiment, is of great value, and, when considered along with the errors made, may be taken as giving reliable information. A summary of the information thus gained may be given as follows.

TABLE VIII.

- B.* *Visual* images most prominent, *motor* next, and *auditory* least.
- G.* *Auditory* and *motor* images prominent, *visual* very slight.
- V. M.* *Visual* very prominent, *motor* next, and *auditory* least.
- W. M.* *Visual* very prominent, *auditory* and *motor* both important.
- E. R.* *Motor* most prominent, *auditory* next, *visual* rarely present.
- L. R.* *Motor* and *auditory* prominent, *visual* slight.
- T.* *Auditory* and *motor* images prominent, *visual* slight.

One of the most noticeable characteristics shown by the introspective reports is that, in the case of one subject (*L. R.*), the letters were rarely remembered directly, but usually through a verbal association formed at the sight of the printed card, this verbal association being in tactual and auditory terms. Other subjects sometimes used verbal associations to aid the memory, but to a much less extent. The indirect method was, however, common among the Juniors. The answers obtained from questioning the subjects in connection with the tests for memory of words, letters, and figures, confirm the conclusions in the above summary. Beside these questions each subject was requested to state where, in his opinion, he should be placed under the degrees of mental imagery (visual imagery) as classified by Francis

Galton in his *Inquiries into Human Faculty*, p. 93. This classification was made from responses received from a large number of individuals questioned in regard to the illumination, definition, and coloring of their mental images. The classification is in full as follows:

Degrees of Mental Imagery. Highest.—Brilliant, distinct, never blotchy.

First Suboctile. The image once seen is perfectly clear and bright.

First Octile. I can see my breakfast table or any equally familiar thing with my mind's eye quite as well in all particulars as I can do if the reality is before me.

First Quartile. Fairly clear; illumination of actual scene is fairly represented. Well defined. Parts do not obtrude themselves, but attention has to be directed to different points in succession to call up the whole.

Middlemost. Fairly clear. Brightness probably at least from one-half to two-thirds of the original. Definition varies much, one or two objects being much more distinct than the others, but the latter come out clearly if attention be paid to them.

Last Quartile. Dim, certainly not comparable to the actual scene. I have to think separately of the several things on the table to bring them clearly before the mind's eye, and when I think of some things the others fade away in confusion.

Last Octile. Dim, and not comparable in brightness to the real scene. Badly defined, with blotches of light; very incomplete; very little of an object is seen at one time.

Last Suboctile. I am very rarely able to recall any object whatever with any sort of distinctness. Very occasionally an object or image will recall itself, but even then it is more like a generalized image than an individual one. I seem to be almost devoid of visualizing power as under control.

Lowest. My powers are zero. To my consciousness there is almost no association of memory with objective visual impressions. I recollect the table, but do not see it.

Below is given the result of the self-classification of our seven subjects under the above divisions.

B.	G.	V. M.	W. M.	E. R.	L. R.	T.
First Octile or possibly first Quartile.	Last Octile.	First Octile.	First Octile.	Last Suboctile.	Last Quartile.	Last Quartile or possibly middlemost.

This result also agrees admirably with that given in the summary above.

III. *Imagination.*

1. *Passive Imagination.* (a) *Method of Blots.* The results obtained from the experiments under this method are susceptible of quantitative expression, but their qualitative aspect is of equal, if not greater, importance. The numerical results are given in Table IX, in which is shown, for each subject, the number of objects seen in each of the ten different blots, and the number of their sum.

The small figures at the left of the last column in Table IX indicate the order of the subjects in respect to the readiness of their flow of ideas,

TABLE IX.
Number of Objects seen in Blots.

	BLOT I.	II.	III.	IV.	V.	VI.	VII.	VIII.	IX.	X.	TOTAL.
B.	5	7	8	5	9	1	5	14	14	13	1. 81
G.	1	4	4	6	5	2	4	3	3	6	5. 38
V. M.	6	6	10	6	6	5	7	8	8	6	3. 68
W. M.	4	3	3	1	4	3	2	3	3	1	7. 27
E. R.	4	4	5	3	6	1	5	4	2	3	6. 37
L. R.	6	8	7	6	6	7	8	6	6	10	2. 70
T.	3	5	4	6	3	6	5	9	8	6	4. 55

or the relative number of associative connections which are at the immediate command of the subjects. The *kind* of associations peculiar to the various individuals must, however, also be considered. The associated objects most frequently mentioned are animals; familiar fruits, plants, tools, household utensils, etc.; scientific objects such as geometric figures, mathematical symbols, schematic drawings, maps, etc.; objects suggested by literary reminiscence; and finally, objects from fable and mythology, such as monsters, fairies, witches, satyrs and centaurs. *B.*, who stands first in regard to number of objects seen in the blots, holds also a high place in respect to variety, since his reports show not only the names of animals and familiar objects, but associations derived from science and a few from mythology. *E. R.* and *M. W.*, who occupy a low position in respect to number of associations, have a corresponding place in regard to variety, since the associations are restricted almost exclusively to names of animals and familiar objects. Of the other subjects, *V. M.* and *L. R.* have shown a somewhat greater variety than *G.* and *T.*, especially in the way of fable and literary reminiscence. These differences in variety may be called the individual differences in regard to the source from which associations are habitually drawn. The reports from this test, however, show further peculiarities,—individual differences which, in general, subsist between single associations, and differences in the manner of reporting all the associations. For example: a particular blot may call up in the mind of a subject, through association, a number of objects similar to this in form, and he enumerates the objects one after another; while to another individual the same blot seems filled with pictures representing some action or situation, which are reported, often with touches of fancy or sentiment. This difference in the reports is sufficiently marked and sufficiently constant to form a basis for the classification of the individuals into two classes: one class rep-

resenting the *constructive* or imaginative type, characterized by the putting together of concrete details in such a way as to form a significant whole; the other class, representing what may be called a *matter-of-fact* or scientific type, characterized by a process more purely analytic in its nature. The following reports from three subjects on Blot IX may serve to make plain the characteristic difference.

1. *Associations few and non-constructive.*

An eagle. Stuffed turkey. Head and neck of a musk-rat.

2. *Associations many and varied, but non-constructive.*

Ghost. Tadpole. Lizard. Ichthyosaurus. Mountains. Wigwams. Totem poles. A plain. A monument. Rocks. Pine trees. Sphinx. Satyr's head. Unknown animal (similar to giraffe).

3. *Associations numerous and constructive.*

Giraffe. Prehistoric bird in flight. Fairy riding on a humble-bee. Bit of tropical jungle, with trailing gray mosses and pools of water. Japanese lady. Bit of landscape with two hills and a valley between—an army encamped under one hill. Moss-grown log floating in water. Fabulous monster (griffin perhaps), walking off on his hind legs with a small Hottentot under his arm.

The constructive tendency is most prominent in *V. M.* and *L. R.* who also, next to *B.*, stand first in point of number and variety of associations; it is plainly discernible in *G.* and *T.*, though to a less degree in the latter than in the former; *B.*, *E. R.*, and *W. M.* must be classed as belonging to the other type.

(b) Test of associations with abstract terms, number forms, etc. None of the subjects had fixed associations with abstract terms, not even those subjects who are remarkably good visualizers. That this is the case tends to confirm the fact, observed by Galton, that persons dealing with highly generalized or abstract ideas habitually suppress any mental imagery that may tend to arise with them, and thus the very tendency disappears. No elaborate forms for the mental arrangement of number was reported by any of the subjects. *B.*, however, arranges the months in a vague circle with winter on the top and summer opposite; and *G.*, who has a color association with all words, letters, and figures, has extra and especial colors for the seasons, which take the form of disks arranged on the circumference of a circle. The latter fact is noticeable because the subject, apart from these color associations, visualizes very little.

2. *Constructive Imagination.* (a) *Mechanical Imagination.* The tests under this heading were two, the Magic Box and the Puzzle Watch. It will be remembered that the two points of explanation which the subjects should have given in regard to the first were the magnetized pivot, and the inner mechanism of gearing and fly wheel connected with the side-arm by means of which the impulse was given. The explanation of the Puzzle Watch lay in the connection of hands and works by means of an inner glass revolving disk and the regulation of the relative movement of the hands by means of tiny gearings in the central pivot. The explanations given by the different subjects may be tabulated as follows.

TABLE X.

<i>Magic Box.</i>		<i>Puzzle Watch.</i>
B.	1. Magnetized pivot. 2. Coiled spring inside released by lever pushed in.	First hypothesis, hands moved by magnetism, corrected in favor of second hypothesis: a plate of glass revolving with hands and a little system of cogs for relative motion.
G.	1. Alternate attraction and repulsion by electric current through pivot. 2. Electric battery inside; circuit closed by lever.	Perhaps hands were magnetized in some unknown way.
V. M.	No explanation.	Perhaps the hands were magnetized.
W. M.	1. Magnetized pivot. 2. Spiral spring inside.	Three hypotheses. First was perfectly correct. Second (which he preferred), invisible wire connection. Third (preferred to either), magnetization.
E. R.	1. Magnetized pivot. 2. Some kind of clock work inside.	Two inner glass disks, one revolving with pivot of minute hand and other with hour hand.
L. R.	1. Magnetized pivot. 2. Coiled spring inside tightened by pulling lever out.	No explanation.
T.	1. Attraction exerted through lid of the box by 2. A magnet inside made to move about in some way.	Suggested magnetism, but failed to see how it could be made to work.

In the first test the explanations given by *B.*, *W. M.*, and *L. R.*, are almost identical, while that of *E. R.* is similar but more indefinite. *T.* and *G.* come next in order with explanations which show that the correct idea is more nearly grasped by the former, while *V. M.* gives no explanation at all. In the second test, *B.*, after giving the hypothesis which suggested itself to nearly all the subjects (magnetism), changed this in favor of the correct explanation; while *W. M.*, who gave the correct explanation first, afterwards preferred to it two other erroneous hypotheses. *E. R.* gave properly the main idea of the explanation. A noticeable difference in the reports of the two tests is that *L. R.*, who gave one of the best explanations of the Magic Box, could offer no suggestion in regard to the Puzzle Watch. *T.*, *G.*, and *V. M.*, whose reports were on slightly different levels in the first test, all suggest the same vague hypothesis in the second. Taking into consideration the reports from both tests, and especially the lapse on the part of *L. R.*, it may be said in general that the subjects most proficient in mechanical inventions are *B.*, *W. M.*, and *E. R.*, a group which coincides with that classed in a previous test as belonging to the matter-of-fact or scientific type, a type showing analytical tendencies. The process here was mainly one of analysis; the coincidence in the grouping, therefore, is one that might have been expected. The classification of the subjects into two groups, with *B.*, *W. M.*, and *E. R.* on the one side and *V. M.*, *T.*, *G.*, and *L. R.* on the other, is also a

grouping according to sex. This may be significant, owing to the fact that men are, as a rule, more familiar with mechanical devices than women.

(b) Literary Imagination. (1) Development of sentences.

TABLE XI.

	Sentences developed using given substantives.		Sentences developed using given verbs.	
	Average number of sentences developed from one group of words.	Average quality of the sentences.	Average number of sentences developed from one group of words.	Average quality of the sentences.
B.	6. 3.5	5. 56	6. 2.6	5. 67
G.	2. 5.8	4. 68	2. 5.4	4. 71
V. M.	4. 4.5	2. 108	4. 3.4	2. 129
W. M.	5. 3.7	6. 55	5. 2.8	6. 69
E. R.	7. 3.2	7. 49	7. 2.5	7. 54
L. R.	3. 4.9	3. 105	3. 4.4	3. 128
T.	1. 6.6	1. 113	1. 5.8	1. 133

Table XI gives averages obtained from ten experiments with substantives and ten with verbs, five minutes being the time allotted for the development of sentences in each experiment. The columns of the Table headed *quality* demand some explanation. In general, quality stands for the degree of elaboration of the sentences, taking into consideration the length, rhetorical form, and especially the range of ideas expressed in a single sentence or in a series of sentences formed by the use of the same 'given' words. The sentences made showed three distinct degrees or stages of elaboration, which may be designated by *A*, *B*, and *C*, and smaller degrees of difference, intermediate between, or shading into these, which may be represented by the symbols of *plus* and *minus*. Sentences in which the three 'given' words were connected into a sentence by the use of as few words or ideas as possible were classed as *A*. Sentences which, by the addition of supplementary ideas, were more complete and definite in themselves, or which implied a context, were classed as *B*; while *C* was taken to designate those sentences in which the ideas were still further supplemented, and the literary form was correspondingly of a somewhat more elaborate character. For convenience in making averages, a numerical value was placed upon each of these symbols as follows: *A*=50, *A*—=40 and *A*+=60; *B*=100, *B*—=80 and *B*+=120; *C*=200, *C*—=160 and *C*+=240. According to this evaluation it will be seen from the Table that *B*'s sentences from

substantives average in quality between *A* and *A+*, and his sentences from verbs average between *A+* and *B-*. The other numbers under 'quality' are to be similarly interpreted. An instance of a sentence under each of the three main headings may serve to make the distinction between them more apparent.

Sentences formed by the use of the substantives, *citizen*, *horse*, *decree*.

A. "Decrees are made for citizens not for horses." (The connection of the words here is simple and mechanical.)

B. "That stalwart citizen on the great gray horse is a man to be trusted with the decree." (This implies a concrete situation.)

C. "All the well-to-do citizens of the village, each mounted on a horse, rode through the streets, proclaiming their dissatisfaction with the new decree." (A situation is here more fully outlined.)

A brief glance at Table XI shows two things: first, that every subject averages fewer sentences composed from 'given' verbs than from 'given' substantives; and, secondly, that every subject averages higher in quality in the latter than in the former. The reason for both facts lies in the greater definiteness with which the substantives determine the sentences: it is comparatively easy to make numerous sentences from definite substantives by changing the verbal connections, but it is difficult thus to change the entire character of the different sentences. The order that subsists among the individuals in regard to number of sentences is the same under substantives and under verbs, while the order in respect to quality is likewise the same under the two headings. If the order under number and under quality be compared, it will be seen that for three subjects, *T*, *L. R.*, and *E. R.*, the order remains the same, at 1, 3 and 7 respectively, both for substantives and for verbs; while, for the other subjects, the order is not radically changed. In general, then, the subjects who made the most sentences also made the most elaborate, and those who made the fewest sentences made also the simplest and most unimaginative. If the subjects are grouped according to their order in regard to number and also in regard to quality, the groups will be found to agree with those observed under the Method of Blots. The group which there showed a tendency toward constructive imagination, here show the same tendency, by their superiority in constructing sentences both as regards number and quality; while those who there showed a comparative lack of that tendency, here manifest the same characteristic by their lower rank in the construction of sentences. Within the constructive group *T*. has in this test advanced to the first place, showing that, to her mind, words possess a suggestiveness superior to that of mere visual outlines.

(2) Development of a theme.

The only quantitative estimate that can be satisfactorily made in this test is the average number of words which a subject uses in the development of a theme: the number of words corresponding roughly with the number of ideas presented. The average number of words

used by the various subjects in developing three themes by narration or description, and three by exposition are given below.

TABLE XII.

	B.	G.	V. M.	W. M.	E. R.	L. R.	T.
Narration or descrip- tion.	7. 124	5. 155	2. 179	3. 174	6. 150	1. 259	4. 173
Exposition.	7. 94	5. 138	3. 159	4. 147	6. 120	1. 222	2. 184

It may here be seen that all the subjects, save one, write longer themes on imaginative topics than on those requiring the treatment by exposition; that is, the topics which have to do with concrete things seem to lend themselves to more spontaneous expression than do the topics which involve the activity of the more purely intellectual processes. *T.* forms the marked exception. To judge from the length of her themes, those of exposition seem to be composed with even greater readiness than the narratives. The order subsisting among the individuals in regard to length of themes is slightly different in the two kinds of writing. This is due, however, to the exceptional difference in length on the part of *T.*; if this were left out of account, the order among the subjects would remain the same in the two cases. A comparison of this order with that in regard to the average number of sentences constructed by the different subjects (see Table XI) shows, as the most striking difference, that here *W. M.* has advanced to a position in the first group, while *G.* has fallen from the second to the fifth place. There are also smaller differences in the order among the individuals in the two groups. These alterations in the order are not of themselves, however, sufficient to warrant a change in the classification of the individuals by imaginative type. The qualitative differences in the themes must also be taken into account.

Narration and description deal with particulars, not with generalization. This imposes on both the same task of seeking out those parts and characteristics of the object which are most individual, most unlike those of the class to which it belongs; all the details chosen are selected with a view to bringing out this unique character of the whole object or event. The material is concrete, the process is mainly synthetic. Exposition, on the other hand is invention dealing with notions or generalized ideas; its business is to set forth the meaning of things, to make clear their nature, scope, and relations. "Exposition is thus," in the words of Prof. Genung, "the handmaid of all accurate and clearly-cut thought." Narration and description demand vividness or picturesqueness of diction, and a certain dramatic force; exposition calls only for clearness and simplicity.

An attentive perusal of the particular themes under consideration with the above qualifications in mind shows, in regard to the imaginative themes, constant individual differences. *L. R.*, *T.*, and *V. M.* here, as before, belonging to the constructive type, exhibit in the highest degree the requisite qualities of concreteness, vividness, etc. *B.* and *G.* seem to be on substantially the same level, their themes being less vivid, more matter-of-fact, with a tendency to generalize the scene or event, and with very slight emotional coloring; the themes of *E. R.* and *W. M.* show these characteristics to a more marked degree. The other set of themes, those dealing with exposition, gives little clue to individual differences, partly because the topics themselves are not such as to admit of very wide choice in the matter of treatment, and partly because the long course of intellectual training which all the subjects had enjoyed tended to lessen, in this sphere, the differences due to mental constitution.

(3) Choice of Topic.

TABLE XIII.

	In a Snowstorm.	A Polar Landscape.	A Puritan Sabbath.	My Opposite Neighbor.	Man Endowed with the Power of Flight.	Civilization not Regeneration.	Wisdom in Charity.	Friendship of Books.	Fiction as a Vehicle of Truth.	The Eloquence of the Bar and that of the Pulpit.
B.				×	×	×	×		×	
G.			×	×		×	×		×	
V. M.			×	×		×	×		×	
W. M.	×		×	×		×	×		×	×
E. R.				×				×	×	
L. R.				×			×	×	×	×
T.			×	×			×	×	×	

Table XIII shows the five topics chosen by each of the different individuals from the ten given topics, five of which were for imaginative, and five for expository writing. The results are chiefly interesting in their collective character. All the subjects showed a preference for the second class of topics, the number of these chosen by all the subjects being almost twice as great as the number of imaginative topics. The usual proportion in the choice of imaginative to expository topics, as shown in the table, is 2 : 3, the only exceptions being in the cases of *G.* and *L. R.*, whose proportion is 1 : 4. The imaginative topics least often chosen are those which make severest demands upon the imagination of the writer. That two of these least popular topics were selected by the three subjects who have been classed as showing less constructive imagination than the others is worthy of note. This, together with the fact that of the subjects who chose the larger proportion of expository topics, one has always been classed with the constructive type, and the other has usually been so classed, seems to

indicate that a particular power of imagination or comparative lack of it does not necessarily imply a preference for or against the exercise of that power in a given case. Tastes and abilities are not always co-ordinate.

The modification of the last two tests given to members of the Junior class show likewise a strong preference for expository subjects over imaginative: two subjects only chose the latter. The outlines for essays which accompanied the topics chosen were not sufficiently diverse in character to form a basis for classifying the individuals.

IV. Attention.

1. Degree of Attention. (a) Cancellation of vowels.

TABLE XIV.

	Pages with Spacing.			Pages without Spacing.		
	Percentage of Error.	Time (sec.).	Percentage of Error reduced to mean time.	Percentage of Error.	Time (sec.).	Percentage of Error reduced to mean time.
B.	8.7	189	3. 8.6	6.2	212	5. 5.5
G.	9.0	214	4. 9.9	3.4	272	4. 4.0
V. M.	3.9	196	2. 4.0	1.2	200	1. 1.0
W. M.	12.1	175	5. 10.1	9.3	198	7. 8.3
E. R.	11.9	198	6. 12.3	1.8	226	3. 1.9
L. R.	18.3	196	7. 18.8	8.2	214	6. 7.9
T.	3.6	164	1. 3.0	2.0	209	2. 1.8

Table XIV shows that, in the case of every subject, the time necessary to cancel a's from pages without spacing exceeds that for pages with spacing, but that the percentage of error in the former is less than in the latter. That is to say, the demands upon the attention were greater in the pages where absence of spacing, punctuation, and capitalization necessitated the perception of each letter as a unit. The separate direction of the attention upon every letter required more time than the perception of the letters grouped into words, with the added process corresponding to the question, "Does this word contain an a?"; but it also insured greater accuracy. The associative process indicated by the question might easily be crowded out by the more interesting associations called up by the meaning of the words and sentences. Distraction, then, operated in the case of proof pages to increase the percentage of error, while in the pages without spacing the increased difficulty of perception caused an increase in the time necessary to perform the task.

The reductions in the third and sixth columns of the Table were made in order to get a relative estimate of the individual which should take account of both quickness and accuracy. The assumption made is that in a given individual, maintaining a constant degree of attention while doing a piece of work, the percentage of error is inversely proportional to the time taken for the work. Under this assumption the percentage of error of each subject was reduced to a common time, the mean of the time for all subjects, and thus all individual differences were reduced to terms of error. The order of individuals in regard to this error is different in the different kinds of pages. *E. R.* rises from the sixth to the third place when the distraction due to the sense is removed: *B.* and *W. M.*, however, are comparatively lower in rank in the second class of pages than in the first. Other divergences of order are more slight.

In the first half of the Table, we find, apparently, three groups: *T.* and *V. M.*,—*B.*, *G.*, *W. M.* and *E. R.*,—*L. R.*; in the second half, also three groups: *T.*, *V. M.* and *E. R.*,—*B.* and *G.*,—*L. R.* and *W. M.*

(b) Comparison of ease (estimated by rapidity) in reading a page of concrete description (without spacing, etc.,) and a similar page of exposition of abstract thought.

TABLE XV.

	B.	G.	V. M.	W. M.	E. R.	L. R.	T.
Time of reading concrete page.	5. m. s. 4.38	6. m. s. 7.12	2. m. s. 3.10	4. m. s. 3.40	7. m. 15	3. m. s. 3.10	1. m. s. 2.23
Time of reading abstract page.	5. m. s. 3.36	6. m. s. 4.12	2. m. s. 2.48	3. m. s. 2.40	7. m. s. 6.45	4. m. s. 3.5	1. m. s. 2.5

Table XV shows that in the case of every individual the time for reading the abstract page was less than that required for the concrete page. There are several reasons why this should be the case. The practice gained by reading the concrete page was of assistance in reading the abstract page which came after. The abstract page had somewhat fewer words (340) than the concrete page (376), and also longer words, which are easier to distinguish than sequences of short words. Moreover, a considerable number of the longer words in the abstract page occurred several times, *e. g.*, such words as 'philosophy,' 'thought,' 'absolute,' 'consciousness,' etc. It cannot, therefore, be said that the superior rapidity of reading the abstract pages is altogether caused by a higher degree of attention resulting from the greater interest excited by the nature of the thought. The order of the subjects in regard to rapidity of reading is almost the same in the two pages; the only change in order being in the cases of *W. M.* and *L. R.*, whose rank alters from fourth and third to third and fourth respectively,—indicating that *W. M.* found the abstract page relatively easier to read than *L. R.* The order

of individuals as seen in Table XV and in the third and sixth columns of Table XIV are hardly comparable, since in the former no estimate is made of the correctness of the reading. Moreover the results in Table XV are made out from single experiments, while those in Table XIV represent the canceling of a's from eight pages with spacing and five pages without spacing. The latter results, therefore, have greater validity.

We regret that these two tests should be so bare of results, since they promise (if more skilfully performed) to yield indications of prime importance as to the make-up of the individual consciousness. We had expected to discover individual differences of much more definite character and much greater amount. The tests evidently involve processes of a highly complex nature, and the conditions must be very carefully regulated if reliable results are to be obtained.

2. *Range of attention.* (a) Writing letters while reading a passage of ten lines.

TABLE XVI.

	Times of Readings.					Number of Letters Written.				Difference in time between 5th and 1st readings.	Proportion of the difference in time to the number of alphabet writ'n.
	1st.	2d.	3d.	4th.	5th.	A.	A. B.	A.B.C.	Alphabet.		
B.	s. 28	s. 38	s. 42	s. 50	s. 113	47	62	78	91	s. 85	7. .94
G.	22	22	22	21	28	29	34	39	40	6	2. .15
V. M.	29	30	30	30	50	40	56	57	46	21	5. .45
W. M.	26	27	27	27	29	27	28	36	13	3	4. .23
E. R.	27	27	29	27	31	31	40	48	20	4	3. .20
L. R.	22	25	26	25	37	41	44	51	26	15	6. .57
T.	27	29	30	31	29	36	40	45	25	2	1. .08

Table XVI is largely self-explanatory. The time of reading, in general, increases with the complication of the accompanying acts. The amount of this increase varies greatly in different individuals. The number of a, b's is greater than the number of a's, but not twice as great; and the number of a, b, c's is greater than the number of a, b's, but not three times as great as the number of a's. That is to say, it is more difficult to write ab repeatedly while reading than to write a simply, but the sequence between these two letters, a and b, is so easy and natural that it is not twice as difficult to write the two letters as to write the one; a subject, therefore, always sets down in the aggregate more letters

when required to repeat a, b than when writing a's. The case is similar with a, b, c. The conditions are different, however, in regard to the alphabet. There the number of characters and the sequences are so greatly increased that the total number of letters written is, in several cases, less than the number of a's; and even where the number of letters is not less, the time taken for the reading and writing is increased. The extreme complication of the acts accompanying the reading, in the case of writing the alphabet, tends to distract the attention from the reading, thus lengthening the time of reading, and to cause a decrease in the total number of letters written during the reading. Sometimes one effect predominates over the other: in *B.*, *e. g.*, it is the lengthening of the time, in *T.* the decrease in the number of letters. The last column but one of Table XVI gives the amount of increase of the time for the fifth reading over that for the first (or normal) reading. The last column, giving the proportion of this difference of time to the number of letters of the alphabet written, indicates the degree of simultaneity (if this expression be permitted) of the two acts. The smaller the increase in time and the greater the number of letters written the smaller is the proportion, and the more nearly simultaneous is the performance of the two acts. The order of the individuals in regard to range of attention as thus indicated in the last column of Table XVI does not correspond to any previous grouping of the subjects.

V. Observation: Discrimination.

1. *Descriptions of Pictures.* Of the two pictures used in these tests, "The Golden Wedding" and "The Interrupted Duel," the former, to a greater degree than the latter, gave results which varied from one individual to another. The first picture possessed far more detail, the composition was less simple, and the interpretation was somewhat less obvious. The descriptions of the "Golden Wedding" show that the observation of the subject may be primarily directed to the particular objects or details of the picture, or to the general arrangement of the objects, that is, the composition of the picture, or to the meaning of the picture, the story which it conveys, the details observed being such as lead up to this interpretation, or explain and apply the interpretation which is given first. The different ways in which the same picture appeals to the various individuals indicate differences in mental constitution. The appeal may be primarily to the intellectual activities of perception, or, through perception, to the imagination and feelings. The descriptions written by *V. M.*, *L. R.*, and *T.* give prominence to the interpretation of the picture, but differ in use of details. In the case of *V. M.*, the details are fairly numerous, concrete in their nature, and seem to be carefully chosen with a view to substantiating the interpretation; in that of *L. R.*, the details which are abundant and minute are given first, and then followed by an interpretation of the whole. In *T.*'s description the

details are less specific in character. The account of the picture given by *G.* contains a general interpretation, a mention of two or three prominent figures, and a general arrangement of the groups of people. The descriptions of *E. R.*, *W. M.*, and *B.* are characterized by entire absence of interpretation; but these subjects also vary in the use of detail. *E. R.* had no recollection of the composition of the picture at all, and mentioned, therefore, only a few objects in the form of an enumeration. *B.*'s description contains mention of a large number of persons and objects, but fails to give any clear idea of the composition of the whole; while that of *W. M.* contains less detail, but conveys a somewhat more complete idea of the total scene. The whole number of different objects (including persons, furniture, utensils, etc.,) mentioned is 20: the number of these specifically referred to in one description varied according to the individual, from 6 to 13. *W. M.*, *E. R.*, and *T.* mentioned 6; *G.*, 1; *V. M.*, 8; *B.*, 11; and *L. R.*, 13. There was a considerable variety, therefore, in the objects selected for mention by the different subjects.—In the "Interrupted Duel" the total number of different objects mentioned was 15, and the proportion of these objects named in the different descriptions was much larger than in the case of the other picture. 8 and 12 were the limits of variation. *G.*, *W. M.*, and *T.* named 12; *B.*, 11; *V. M.*, 10; and *L. R.*, 8: *E. R.* failed to recall the picture at all. Since the scope for selection of objects was in this picture more limited, the descriptions of the different individuals were more similar in character. This similarity was further enhanced by the fact that the picture so plainly revealed the subject it was intended to represent, the result being that an interpretation of the picture was given by all (*E. R.* excepted), though that of *L. R.* was erroneous, owing to her failure to observe the minor group in the picture. The individual differences observable in the descriptions of the "Golden Wedding" tend to become neutralized in the "Interrupted Duel" by the greater use of interpretation on the part of *B.* and *W. M.*, and a somewhat less use of it by *L. R.*, *T.* and *G.* In *V. M.*, however, the tendency to interpret is, if anything, emphasized, and her description takes the form of a narrative, explaining the situation portrayed in the picture. For the reasons assigned above, the "Golden Wedding" is the picture better suited for a test of this kind. The results from it, therefore, may be accepted as revealing more characteristic differences in the individuals. These results are, as a matter of fact, in substantial agreement with those obtained in the tests for imagination.

2. *Observation of Colors.* In this test, it will be remembered, the subject was not given full information before the beginning of the experiment. It was only after he had looked at the card for the stated time (five seconds), that he was requested to name all the prominent colors on the card, with their respective situations. As the experiment could not be repeated under precisely the same conditions,

the test was given but once, and the results, therefore, may not be such as would be precisely confirmed by further testing.

TABLE XVII.

	Percentages correctly given.		Percentages incorrectly given.		Mean of (correct percentages—errors).
	Colors.	Situations.	Colors.	Situations.	
B.	50	25	0	12.5	6.
G.	75	62.5	0	0	1.
V. M.	37	37	0	0	5.
W. M.	62.5	12.5	0	0	4.
E. R.	25	0	12.5	0	7.
L. R.	62.5	62.5	0	0	2.
T.	50	50.0	0	0	3.
					50.00

The results are interesting as showing that the subjects who are the best visualizers observed the colors and the place they occupied in the picture less well than did others whose mental images are predominantly in some other sense department. *E. R.*, however, who proved to have the fewest and faintest visual images, seemed here, as in the previous experiment with pictures, to have the least power of reproducing visual impressions. Since the same subject showed relatively much greater facility in the reproduction of letters and figures under the method of procedure with knowledge, it is probable that in the case of the pictures attention was not sufficiently aroused to enable the subject to form verbal associations with the visual impressions. If these associations had been formed, especially with the colors, which were so few, they could hardly fail to be recalled so soon after their formation. It is to be further observed that the order indicated in the last column of Table XVII does not agree with the order in regard to particular objects mentioned in connection with either of the pictures of the previous tests. The general grouping of subjects, however, is somewhat similar in the two cases, if descriptions of pictures are considered in respect to their total merit; the chief differences being that *G.* and *W. M.* have in Table XVII advanced from their former positions. This fact may be of significance, when it is remembered that these two subjects excelled in the memory of unconnected visual impressions (letters and words).

3. *Discrimination of Synonyms.*

The discriminations were marked in regard to quality according to the scale of A, B and C, as described under the test of Development

of Sentences,—quality in this case, however, signifying the degree of clearness and completeness of a discrimination. C, here as before, signifies the highest quality. The results of the averages of the numerical values given to the discriminations of the different subjects make it appear, as seen in the Table, that the value of *B.*'s discrimina-

TABLE. XVIII.

	Average quality of discrimina- tions.	Average length of discrimina- tions (words).	Total number of derivations.	Total number of examples.
B.	5. 89	7. 25	0	3. 14
G.	2. 106	6. 30	0	2. 2
V. M.	4. 97	2. 54	5	2. 17
W. M.	6. 76	4. 44	0	2. 2
E. R.	7. 77	5. 36	0	2. 2
L. R.	3. 103	1. 65	0	1. 44
T.	1. 119	3. 49	0	4. 5

tions average about midway between B— and B, that of *G.*'s between B and B+, and so on. The remaining columns of the Table are self-explanatory. The limits of variation in quality for the different subjects the Table shows to be very narrow. The lowest quality (76) is almost B—, and the highest (119) is just less than B+. The tendency of the past training of all the subjects was towards cultivation of the powers of intellectual discrimination. There is no strongly marked parallel between clearness and completeness of the discrimination, and number of words used in its expression. *G.*'s discriminations are notable for clearness combined with conciseness of statement; for the rest, there seems to be a slight balance of clearness in favor of the longer discriminations. The tendency to illustrate the thought by means of concrete examples is shown most strongly in *L. R.*, *V. M.*, and *B.* Of these the two former have exhibited the same tendency toward the concrete in the development of themes. On the whole, this test, like that of the development of the topics for exposition, is of somewhat too general a character to bring out individual differences in regard to those activities in which the subjects most resemble each other by reason of their previous training and of the tendencies which lead to the choice of this training.

The discriminations of synonyms by members of the Junior class were more uneven in quality; but the presence of a considerable number of excellent discriminations tended to bring the mean value for the Junior students very nearly to that of the more advanced students.

VI. *Tastes.* (Æsthetic Tests.)

The Art, Music and Literary tests, which may be roughly classed as Æsthetic tests, gave the results noted in Table XIX.

TABLE XIX.

	ART TESTS.			MUSIC TESTS.		LITERARY TESTS.		
	Percentages of correct answers from given pictures.	Number named in five minutes.		Number of Musical Composers named in five minutes.	Percentages of correct answers as to compositions by given Composers.	Percentages of correct answers.		
		Famous Artists.	Famous pieces of Plastic Art.			Authors of given prose selections.	Authors of given poetic selections.	Sources of given poetic selections.
B.	54	21	18	16	90	62.5	62.5	25
G.	51	18	7	8	50	37.5	50.0	50
V. M.	43	15	12	11	40	87.5	62.5	50
W. M.	8	7	9	3	30	62.5	25.0	0
E. R.	10	2	7	9	20	50.0	62.5	50
L. R.	55	12	9	9	50	62.5	50.0	25
T.	63	37	14	25	100	75.0	87.5	75

The comparative results for the different subjects are more clearly shown in Table XX, in which the subjects are classified into the groups into which the numerical results in Table XIX seem to make them naturally to fall. The second part of Table XX summarizes for each subject the positions, according to groups, occupied throughout the tests, and gives also the final order of the subjects considering the æsthetic tests as a whole.

If it is assumed, as has been done in these tests, that a subject's knowledge of the best works and workers in the fine arts is some criterion of his appreciation of these arts, and if it is further assumed with Professor Külpe that "the æsthetic feeling originates in a *relation of the perceived impression to the reproduction which it excites*," i. e., that an impression which has a considerable, but not intense, degree of effectiveness for reproduction produces pleasure, it is interesting to note the final order of subjects, as seen in Table XX, in comparison with the order of subjects in regard to the average number of objects called up by association with given blots of ink. The similarity of order in this test and in that of blots is sufficient to call for remark. *V. M.* (2), *G.* (5), *E. R.* (6) and *W. M.* (7) remain the same in both; but while the order of *B.*, *L. R.*, and *T.* was (1), (3) and (4) respectively for blots, it became (3), (4) and (1) in the later test. The reason for this difference in order is not clear.

The questions in regard to favorite reading, preference for theater

TABLE XX.

	First Group.	Second Group.	Third Group.	Fourth Group.	Subjects and final order.	First Group.	Second Group.	Third Group.	Fourth Group.
						times.	times.	times.	
Art Tests.	I. T., L. R., B., G., V. M.	E. R., W. M.			3. B.	4	3	1	
	II. T.	B., G., V. M., L. R.	W. M., E. R.		5. G.	1	4	3	
	III. B., T., V. M.	L. R., W. M.	G., E. R.		2. V. M.	4	4		
Music Tests.	I. T., B., V. M.	L. R., E. R., G.	W. M.		7. W. M.		3	3	2
	II. T., B.	G., L. R., V. M.	W. M., E. R.		6. E. R.		4	4	
					4. L. R.	1	5	2	
Literary Tests.	I. V. M., T.	B., W. M., L. R.	E. R., G.		1. T.				
	II. T.	B., V. M., E. R.	G., L. R.		W. M.				
	III. T.	G., V. M., E. R.	B., L. R.		T.	8			

or opera, fondness for reflective games, etc., produced answers which, in several cases, threw light upon changes in the grouping of the subjects in the three different classes of æsthetic tests. It is unnecessary to cite the answers here; it is enough to state that the questions proved to be worth asking.

The art tests with photographs and the music tests which were given to the Juniors showed, as a result, a uniformly lower percentage of correct answers in both cases. The individual differences were of slightly smaller range but were fairly constant throughout the tests.¹

§ 6. *Conclusion.*

It is not our intention to print in this place a complete summary of the results of all experiments for the different individuals. Such a summary, has, of course, been made by us; but, in the first place, it leaves too many gaps to allow a definite differentiation of each individual from all the others, owing largely to the limited bounds within which the enquiry was purposely confined, while, secondly, we have considered it best that the reader, if he will, shall make such a summary for himself, and in this way form his estimate of the value of the tests. Our aim was principally to investigate the merit of a general method: to find the value for Individual Psychology of experimentation applied to the more complex mental activities, as well as the practicability of certain specific tests, many of which had been suggested by the advocates of such experimentation.

It will be remembered that we noted above two main problems of Individual Psychology; the first problem having reference mainly to *variations* themselves, that is, to the way in which psychical processes vary in different individuals, and according to classes of individuals; the second, to the *relations* among variations. The latter, to be sure, includes the question how individuals vary in regard to psychical processes, but it goes on further to ask how these individual variations are related to each other, when the whole range of mental processes is considered. It is this part of the problem to which attention has been directed in the present investigation, by means of the third method mentioned in the preliminary discussion, *i. e.*, the 'method of tests.'

¹ A remark should be made in regard to the absence of detailed discussion of results from the Junior students. The purpose in view when the tests were first given to the Juniors was to compare results from the class as a whole with the general results from the advanced students. Since, however, the exclusive use of the collective method restricted the number of tests which could be given to the Juniors, and the occasional absence of different individual members of the class caused incompleteness in the tests that were given, it was impossible to compare, step by step, the variations as seen in the advanced students with those observed in the Juniors. The comparison, therefore, could be made only in a general way. This comparison has, nevertheless, been found to be useful, and a careful working over of all the results convinces us that the idea upon which it was based was well warranted. Had the scope of the testing been somewhat more extended, results of interest and importance could, we believe, have been obtained.

The results, we believe, have shown that, while a large proportion of the tests require intrinsic modification, or a more rigid control of conditions, others have really given such information as the Individual Psychologist seeks. Thus the tests for Imagination proved to be important as forming a basis for a general classification of the individuals, according to fairly definite types; and results from other tests gave some force of confirmation to this classification, as *e. g.*, the test on Observation by description of pictures. In general, however, a lack of correspondences in the individual differences observed in the various tests was quite as noticeable as their presence. The total change in the order of subjects in the memory of single short series of words and in the recapitulation of the words of seven short series, the fact that those subjects who showed best observation of colors were not the best visualizers, are instances of this lack of correspondence, of which many others could be cited. Whether the fact indicates a relative independence of the particular mental activities under investigation, or is due simply to superficiality of testing, can hardly be decided. While, however, we do not reject the latter possibility, we incline to the belief that the former hypothesis is in a large proportion of cases the more correct.

But little result for morphological psychology can be obtained from studies of the nature of the above investigation. So many part-processes are involved in the complex activities, and the manner of their variation is so indefinite, that it is seldom possible to tell with certainty what part of the total result is due to any particular component. It is doubtful if even the most rigorous and exhaustive analysis of test-results would yield information of importance as regards the structure of mind. At all events, there is not the slightest reason to desert current laboratory methods for the 'method of tests.'

The tests employed, considered as a whole, cannot be said to yield decisive results for Individual Psychology if applied *once only to individuals of the same class*. This statement the above discussion of tests seems perfectly to warrant. *Series of such tests* are necessary in order to show constant individual characteristics. The tests, to be sure, (1) if enlarged in extent to cover a wider range of activities, might be useful for roughly classifying a large number of individuals of very different training, occupation, etc., provided that the greatest care were taken that the conditions in the case of each individual should be as favorable as possible. And, on the other hand, (2) certain groups of tests, especially selected for a particular purpose, and applied, once each in series, to a limited number of individuals, might yield valuable information on points which particular circumstances rendered

of practical importance. As engineers, pilots, and others who have to act upon information from colored signals, are roughly tested for color blindness, so other classes might often profitably be submitted to a psychological testing of those higher activities which are especially involved in their respective lines of duty.

All this, however, is largely beside the point; much preliminary work must be done before such special investigations can be of any great worth. This appears plainly from the present investigation where the positive results have been wholly incommensurate with the labor required for the devising of tests and evaluation of results. In the present state of the science of Individual Psychology, there can be little doubt that the method of procedure employed by M. Binet is the one most productive of fruitful results: that, namely, of selecting tests, and applying them to a number of individuals and classes of individuals with a view of discovering the chief individual differences in the mental activities to which appeal is made. To this should be added, however, an exhaustive study of the results from series of similar tests given to a small number of individuals at different times and in varying circumstances, in order to discover how constant the differences are, and how much of the variation may be due to changes in mental and physical condition, environment, etc. When this procedure has been followed for tests that cover all the principal psychical activities, then the investigation of limited groups of individuals for the purpose of characterizing them in respect to their mental differences may be undertaken with hope of easy and accurate results. The previous study will have made clear the many conditions involved, and the best way of modifying the 'test method' to suit varying circumstances.

In fine, we concur with Mm. Binet and Henri in believing that individual psychical differences should be sought for in the complex rather than in the elementary processes of mind, and that the test method is the most workable one that has yet been proposed for investigating these processes. The theory of the German psychologists, who hold that the simplest mental processes are those to which the investigator should look for a clue to all the psychical differences existing among individuals, we believe would be productive of small or, at any rate, of comparatively unimportant results. Whether the anthropometrical tests so largely used by American workers in this field of psychology will lead to any such correlation of these traits with those of a purely psychical character as has been suggested by some pursuing the inquiry, is a question which must be left for the future to decide. No adequate data are as yet at hand, and (as has been stated above) the American

workers have formulated no explicit theory of Individual Psychology. The method here outlined should (and may), however, be rendered more exact by modifications in accordance with the procedure of the German investigators of Individual Psychology. A combination of the principal characteristics of the two methods is, then, it seems to us, best calculated for the attainment of satisfactory results.

